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OCTOBER

GEOGRAPHY'S PART IN THE PLANT COST OF IRON AND
STEEL PRODUCTION AT PITTSBURGH, CHICAGO,
AND BIRMINGHAM

Langdon White, *Economic Geographer*, Randolph-Macon Woman's College

READJUSTMENTS IN POST-WAR COTTON CULTURE

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TUNG OIL: FLORIDA'S INFANT INDUSTRY

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THE FARM PROBLEM

Robert Stewart, *Agriculturalist*, University of Nevada

FOREST REGENERATION IN PORTO RICO

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THE TOPOGRAPHIC MAP OF THE UNITED STATES

Guy Elliott Mitchell, *U. S. Geological Survey*

AGRICULTURAL REGIONS OF SOUTH AMERICA

Clarence F. Jones, *Economic Geographer*, Clark University

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LOCATION

GEOGRAPHY is centered about place as history is about time, geology about rocks, botany about plants, or ethnology about race. Location is the primary factor in geographic environment, for from it depend all the others. Merely to state the location of a city, or of a people, or of a plant is to tell a great deal about its character or its development.

And it has been so throughout history. The evolution of the lowliest lichen, the lithest larch, or the loveliest lily; of the slowest snail or the swiftest swallow; of the crudest Cro-Magnon or the most refined Roman, has been determined by the place in which it proceeded, by the elements that entered into its location. Civilization itself is the product of a series of locations each making its imprint upon the plastic form of each successive culture.

Modern industry, like all activities of modern man, is extremely sensitive to the critical qualities of location. The slightest advantage in some one quality in a site may bring success; the slightest disadvantage in another, failure. Whether it be an element of climate, an attribute of relief or soil, a feature of the natural vegetation, a reserve of some rich ore, or a source of power, that determines whether the balance shall tip to success or failure, the critical factor is none the less powerful. There is no escape from the inexorable influence of location.

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GEOGRAPHY'S PART IN THE PLANT COST OF IRON AND STEEL PRODUCTION AT PITTSBURGH, CHICAGO, AND BIRMINGHAM

Langdon White

Economic Geographer, Randolph-Macon Woman's College

IN this day of highly competitive business, every country and every district strives to produce its iron and steel at the minimum cost. Generally speaking, the United States is a high cost producer and would be at a considerable disadvantage if forced to compete on a large scale with foreign rivals in neutral markets. Fortunately, however, the country's greatest market is at home, and production only slightly exceeds consumption—31,015,364 and 30,795,768 gross tons of pig iron respectively in 1919. Moreover, foreign competitors cannot successfully invade America except along its periphery, and this means little inasmuch as the largest markets lie not there but in the heart of the country, near the center of population, which is in central-western Indiana. Thus, freight rates act as a highly protective customs tariff.

However, one cannot speak fairly of *American production costs*, for these vary greatly from district to district. The basic factors in plant cost of iron and steel are (1) the cost of ore per unit of iron at the mine, (2) the cost of fuel at the mines or coke ovens, (3) the cost of the fluxing dolomite or limestone at the quarries, (4) the cost of transporting to the

furnaces each of the above basic raw materials, and (5) the cost of labor at every step from the ore to the finished product.

THREE DISTRICTS CLAIM LOWEST PRODUCTION COSTS

A perusal of the relevant literature on the cost of iron and steel production in the United States discloses the astonishing anomaly that three of the nation's greatest districts—Pittsburgh, Chicago-Gary (Calumet), and Birmingham—all claim the distinction of making the cheapest iron and steel. Excerpts from a few of the more reliable references follow:

1. "Judge Gary defended the custom of basing prices on Pittsburgh, saying that is the cheapest point of production, as the cost of furnishing fuel at Pittsburgh is less than in the Chicago District." *The Iron Age*, Dec. 28, 1922, p. 1719.)

2. "The cost of producing steel at respondent's Chicago and Birmingham plants is approximately 20 per cent less than at their Pittsburgh plants. The cost at Birmingham is slightly less than at Chicago." (*Federal Trade Commission Versus the United States Steel Corporation*, Docket No. 760, p. 17.)

3. The Chicago-Gary District "has an advantage over the Pittsburgh District in the cost of producing these four commodities (structural shapes, plates, merchant bars, and black sheets) of 14.5 per cent. In fact steel can be produced cheaper in the Calumet (Chicago-Gary) District than anywhere else in

the country. The highly effective organization of the industry there, the modern equipment employed and the proximity to Chicago are among the outstanding advantages of the Calumet District." (Appleton, John B., "The Iron and Steel Industry of the Calumet District," *University of Illinois Studies in the Social Sciences*, Vol. XIII, No. 2, 1925, p. 34.)

4. "If our national industry as a whole were as favorably situated as the plants in the Birmingham, Alabama, District, there would be nothing to fear. (Mr. Dennis is speaking of foreign competition.) The cheapest pig iron in this country is produced in this district, where the mills literally sit astride of coal, iron ore, and fluxing material." (Dennis, Alfred Pearce, "The Menace of German Competition," *The Saturday Evening Post*, April 9, 1927, p. 50.)

5. "The Alabama iron district is one of the cheapest, if not the cheapest iron district, in the entire world. It possesses a phenomenal natural equipment. Jutting out of the hill-sides that flank one side of the broad open valley are thick deposits of iron ore. On the other side of the valley are the coal mines and the coke ovens, and the limestone is at hand. Instead of carrying the iron ore a thousand miles, as at Pittsburgh or England, or fuel six hundred miles as at Lake Champlain, the raw materials of these southern furnaces are shifted across the valley by switching engines, and the local supply of cheap black labor helps to give a wonderfully low cost." (Smith, J. Russell, *The Story of Iron and Steel* (New York, 1919), p. 66.)

As a result of these divergent views, field work was undertaken for the purpose of determining which were accurate and why. Also, a study was made of each district's raw materials—the sources and the cost of assembly. This latter phase of the investigation seemed imperative, since ore, fuel, and flux make up from 78 to 90 per cent of the total furnace cost and their transportation accounts for about 50 per cent of their price at Lake Erie ports. Hence, they act as a gauge of the cost of production.

This paper does not purport to be an *exhaustive* study of iron and steel



FIGURE 1.—The Pittsburgh District—capital of America's and of the world's iron and steel industry. It comprises everything within a radius of 30 miles of the City and County Building, since the population and industries so enclosed are dependent primarily upon corporate Pittsburgh. The city limits by no means *limit* the city.

Steel is to the denizens of this district what corn is to those of Iowa—the outstanding topic of thought and discussion. In short "Pittsburgh" and "steel" are synonyms.

costs: it gives only slight attention to the cost of labor, and the importance of modern machinery and efficient methods. This is so not because they are unimportant, but rather because they are predominantly less important in determining the *plant cost* of iron and steel than the cost of the raw materials delivered at the furnace tops.

THE PITTSBURGH DISTRICT

The Pittsburgh District (Fig. 1) is that great hive of industry, including the city *per se* and its many satellite cities and towns within a radius of 30 miles of the City and County Building. Within it the people and industries are distributed along the valleys and stream courses "like the blood vessels of a gigantic body," for in this maturely dissected plateau, level land is scarce. Pittsburgh's city-limits no more *limit* it than the "loop" limits Chicago.

This district is the capital of America's iron and steel industry, utilizing about one-fourth of the annual iron ore production of the Lake Superior Region and producing about one-fourth of the nation's steel. While it produces its pig iron and steel more economically than the Chicago-Gary (Calumet) District, it makes it less economically than Birmingham (Table I). Pittsburgh's distinctive rank is consequent upon (1) the momentum of its early start, (2) its proximity to Connellsville coal—the standard coking fuel of the world, (3) its excellent location astride three navigable rivers which extend north, south, and west, (4) its site at an important gateway through the Appalachian barrier, (5) its proximity to Lake Erie ports to which iron ore is cheaply transported, (6) its nearness to important steel markets—it lies within 450 miles of 60,000,000 people or one-half of the country's total population, and (7) the Pittsburgh Plus (important until 1924, when it was abolished by the Federal Trade Commission).

TABLE I
RAW MATERIAL COSTS PER METRIC TON OF PIG IRON IN
THE PITTSBURGH, CHICAGO-GARY, AND
BIRMINGHAM DISTRICTS—1926

| District | Metallic Mixture * | Coke † | Flux | Total |
|-----------------|-----------------------|--------|--------|-----------|
| Pittsburgh..... | \$9.90 | \$4.00 | \$0.60 | \$14.50 ‡ |
| Chicago..... | 7.85 | 6.75 | 0.50 | 15.10 ‡ |
| Birmingham..... | 6.37 | 4.74 | 0.16 | 11.27 § |

* Based upon 95 units iron in ore.

† Coke consumption estimated at 2,000 pounds for domestic ores up to 2,700 pounds for lowest grade ores.

‡ Tyler, Paul M., metallurgist and economist, Washington, D. C. Personal communication.

§ Dyer, Y. A., metallurgical engineer, Birmingham, Alabama. Personal communication.

PITTSBURGH IN RELATION TO THE BASIC RAW MATERIALS FOR IRON-MAKING

Pittsburgh's proximity and easy access to great resources of high-grade coal probably have been the decisive factors making it the hearth of the nation.

Coal

It was these factors which caused the industry in the sixties to migrate from the anthracite region of eastern Pennsylvania across the Appalachian Mountains to the Ohio Basin.

In this region the Pittsburgh Bed is the most important and has so overshadowed the others that they have scarcely been developed. This bed is celebrated for its wide extent, its great thickness, its excellence, and its ease of mining.

The transportation facilities between Pittsburgh and its coal-producing area are excellent. All the streams and therefore all the railroads focus on Pittsburgh, giving it an unusually strategic commercial location. Moreover, the Ohio, the Allegheny, and the Monongahela Rivers are all navigable, and immense tonnages of coal move over them by barge. In 1923 the tonnage of the Monongahela River, mostly coal and coke, was 23,560,000 tons; that of the Monongahela Railway, which parallels the river's banks, was 13,084,000 tons. The average haul on the Monongahela is about 42 miles, which means low transportation costs to the coke ovens and blast furnaces (Table II).

TABLE II
FREIGHT COST OF ASSEMBLING IRON ORE, COAL, AND FLUX
PER LONG TON IN THE PITTSBURGH, CHICAGO-GARY AND
BIRMINGHAM DISTRICTS, 1924-1926

| District | Iron Ore | Coal | Flux | Total |
|-------------------|-------------|--------|--------|--------|
| Pittsburgh..... | \$2.97 | \$0.50 | \$1.26 | \$4.73 |
| Chicago..... | 1.74 | 3.29 | 0.55 | 5.58 |
| Birmingham *..... | 1.25 | 1.10 | 0.30 | 2.65 |

* Data for Birmingham from "Iron in Pigs," United States Tariff Commission (Washington, 1927), p. 20.

If the rail rate (\$1.13 per net ton) on coal from Connellsville to Pittsburgh were used instead of the barge rate from the California District on the Monongahela River, and if the rail-lake rate on coal were used from eastern Kentucky and West Virginia

to Chicago, which is 50 cents per ton less than the all-rail rate, the total assembly costs at Pittsburgh would exceed those at Chicago—\$5.36 *vs.* \$5.08. But this would be unjustifiable, because Pittsburgh gets the bulk of its fuel by barge, and Chicago gets the bulk of its fuel by rail.

Iron Ore

Pittsburgh's iron ore comes from the Lake Superior Region. It is carried by rail from the mines to Ashland, Duluth, Marquette, Superior, and Two Harbors on Lake Superior and to Escanaba on Lake

Limestone

The bulk of the fluxing limestone used in Pittsburgh's blast furnaces is brought by rail from Huntingdon County in south-central Pennsylvania. Consequently, the assembly cost is high (Table II), being more than twice as great, for instance, as at Chicago. However, relatively little limestone is used in the manufacture of a ton of pig iron.

PITTSBURGH IN RELATION TO LABOR

The cost of labor in Pittsburgh is higher in nearly every department

TABLE III *
AVERAGE HOURLY EARNINGS IN EACH DEPARTMENT, ALL OCCUPATIONS COMBINED, 1924, BY DISTRICTS

| District | Blast Furnaces | Bessemer Con- verters | Open- Hearth Furnaces | Puddling Mills | Bloom- ing Mills | Plate Mills | Standard Rail Mills | Bar Mills | Sheet Mills | Tin- Plate Mills |
|------------------|-------------------|-----------------------------|-----------------------------|-------------------|------------------------|----------------|---------------------------|--------------|----------------|------------------------|
| Eastern | \$0.496 | ..... | \$0.533 | \$0.652 | \$0.594 | \$0.433 | ..... | \$0.583 | ..... | ..... |
| Pittsburgh | .561 | \$0.636 | .642 | .897 | .629 | .609 | ..... | .626 | \$0.829 | \$0.843 |
| Chicago | .576 | .610 | .671 | .717 | .628 | .620 | ..... | .613 | .784 | .697 |
| Birmingham | .380 | ..... | .572 | .506 | .506 | ..... | ..... | .428 | ..... | ..... |
| Total | \$0.520 | \$0.624 | \$0.635 | \$0.721 | \$0.613 | \$0.562 | \$0.573 | \$0.585 | \$0.809 | \$0.795 |

* "Wages and Hours of Labor in the Iron and Steel Industry: 1907 to 1924," *Bulletin of the United States Bureau of Labor Statistics*, No. 381 (Washington, 1925), p. 11.

Michigan. The freight rate from Minnesota mines to Lake Superior ports is 91 cents per ton, and from the mines on the Gogebic Range in Michigan and Wisconsin to Ashland 82 cents. It is then transported *cheaply*—70 cents per ton—a thousand miles over the lakes by specially designed boats to the Lake Erie ports of Ashtabula, Cleveland, Conneaut, and Fairport, where it is unloaded and taken by rail 141 miles to Pittsburgh. The cost of unloading this ore at the ports is not great—13 cents per ton—but the rail haul is quite expensive—\$1.23. Since the cost of transportation depends largely upon the grade of the road bed, the railroads that constructed the ore-carrying lines located them with but one end in view—to obtain the lowest possible percentage of grade.

than in the two other districts (Table III). This is consequent upon living costs which are considerably higher than in Birmingham (p. 334) and slightly higher than in Chicago.

THE CHICAGO-GARY (CALUMET) DISTRICT

This district, located along the southwestern shore of Lake Michigan (Fig. 2), differs from Pittsburgh and Birmingham, in that it lies far removed from every one of the basic raw materials for iron-making. Consequently it produces its iron and steel at greater cost (Table I). Nevertheless, it is the most scientifically located district in the country, for *ore, fuel, and flux meet here the center of steel consumption*. Moreover, it secures its ore and flux cheaply, inasmuch as they are delivered by lake

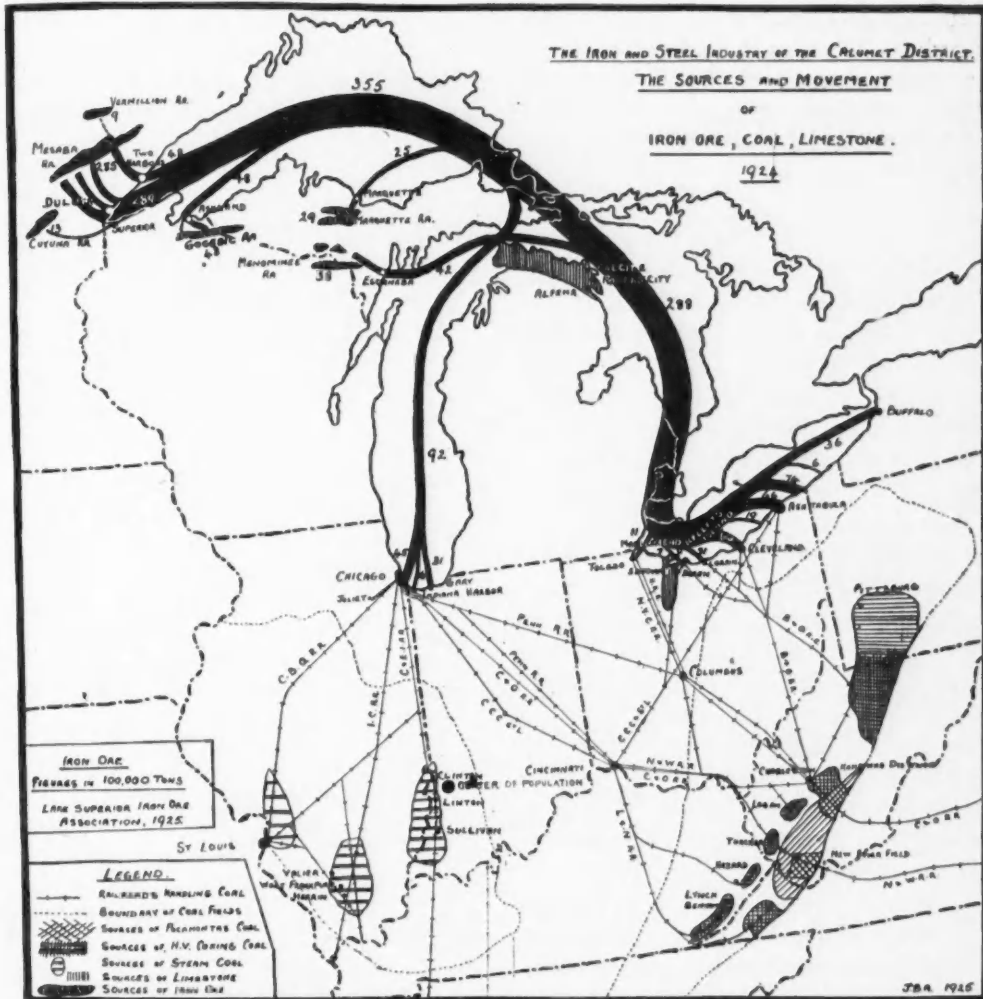


FIGURE 2.—The Calumet District, comprising that great sweep of lake front from South Chicago to the eastern limits of Gary, has the most scientific location of any district in the United States, for here the iron ore, coal, and limestone meet the center of steel consumption. While it lies far from all the basic minerals, the fact that its furnaces adjoin the receiving docks means cheap transportation costs on ore and flux. Even a part of the coal is water borne.

Note the district's proximity to the country's center of population which is synonymous with being near the center of consumptive capacity. (Map from "The Iron and Steel Industry of the Calumet District," by John B. Appleton.)

steamers directly to the water-side blast furnaces.

In order to minimize its disadvantage relative to coal (p. 332) this district probably tops the list relative to careful fuel economy. It accomplishes this by using the most modern equipment and by applying the most efficient methods.

CHICAGO IN RELATION TO THE BASIC RAW MATERIALS FOR IRON-MAKING

Chicago is, on the whole, more advantageously situated than Pittsburgh so far as iron ore and limestone are concerned.

Iron Ore

Chicago, like Pittsburgh, gets its huge supply of iron ore from the Lake

Superior Region. But, unlike Pittsburgh, it receives it by boat directly at the furnaces, thereby saving in transportation costs as compared with Pittsburgh, about \$1.23 per ton (Table II).

Coal

Chicago is less advantageously located with reference to blast furnace fuel than the city at the head of the Ohio. Instead of transporting its supply cheaply by barge 40 or 50 miles as does Pittsburgh, it of necessity brings a large part of its supply some 600 miles by rail from eastern Kentucky and West Virginia at considerable expense—\$3.29 per net ton for Pocahontas (Table II). This is significant when one reflects that the cost of coking coal constitutes a very expensive item in the manufacture of iron and steel. It is estimated that at least one-fourth of the district's supply of eastern smelter fuel is shipped in by boat from Toledo, Sandusky, and Ashtabula. When fuel moves via the lake-rail route, a saving is effected of from 45 to 50 cents per ton.

The steam coal used in this district comes from Illinois and Indiana. Its cost of transportation varies from \$1.60 to \$1.95, depending upon the locations of the mines.

Limestone

Chicago secures its supply of limestone at considerably less cost than Pittsburgh (Table II). Because of its location on the lake, practically all the limestone is delivered by steamer directly to the blast furnaces. The bulk of it comes from the northern shore of the southern peninsula of Michigan and from Kelley's Island and Marblehead, near the western end of Lake Erie. A small amount

is secured from McCook, Illinois, not far from the furnaces. The average cost of Chicago's fluxing material delivered is only about \$1.50 per ton.

CHICAGO IN RELATION TO LABOR

The cost of labor in this district is slightly less than at Pittsburgh, but greater than at Birmingham (Table III).

THE BIRMINGHAM DISTRICT

The Birmingham District, located at the southern end of the Great Valley, mines about 10 per cent of the nation's iron ore and makes about 7 per cent of its pig iron. Its blast furnaces are situated in the valley at Birmingham, and its satellite towns of Bessemer, Ensley, Fairfield, Oxmoor, Thomas, and Woodward, where gravity aids materially in solving the transportation problem on the ore and coal, products of small value but of great weight and bulk.

Since this district lies astride of all three raw materials (Fig. 3), it enjoys the lowest assembly costs in the country, which gives it a competitive advantage. The Tariff Commission reports (1924–1926) that since ore and coal are so close together in this district, the cost of assembling them is almost negligible (\$2.65), and Tyler states that in 1923 the total assembly costs calculated from actual furnace mixtures in the Birmingham District were \$1.95.

BIRMINGHAM IN RELATION TO THE BASIC RAW MATERIALS FOR IRON-MAKING

Birmingham's advantages in the matter of raw materials though not obvious are none the less real.

Iron Ore

Birmingham's iron ore comes from Red Mountain, which borders Bir-

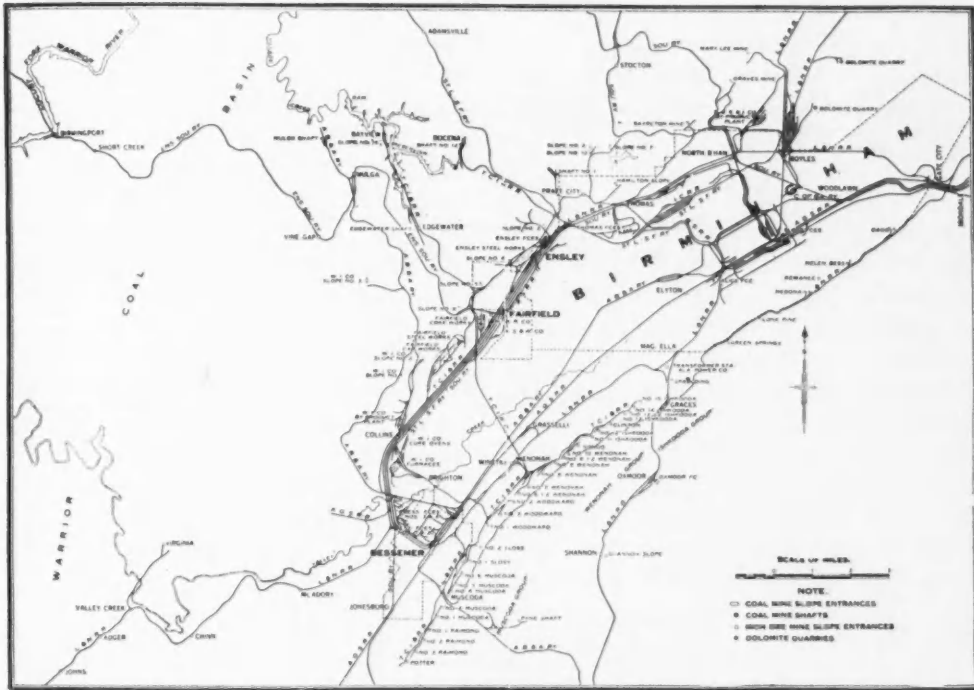


FIGURE 3.—The Birmingham District alone has the ideal juxtaposition of raw materials for iron-making: on the east is a huge reserve of iron ore; on the west is a mammoth store of good coking coal, and in the valley bottom is an almost inexhaustible supply of fluxing dolomite—all within a radius of 15 miles of one another. In the midst of this natural storehouse, lies Birmingham, the "Magic City of the South," with its satellite iron-making towns—the assembling and blending core of the South's iron and steel industry. (Map from "Mining and Steel-Making Methods in Alabama," by the Tennessee Coal, Iron and Railroad Company.)

mingham Valley on the east (Fig. 3). Despite the fact that this ore (1) contains less metallic iron than Mesabi—37 as compared with 51 per cent—and (2) is more difficult and costly to mine, inasmuch as it must be worked by slopes, it does not suffer, because it (1) is abundant, the reserve, above a depth of 3,500 to 4,000 feet, being estimated in 1924 at about 2,000,000,000 tons, an amount equal to that in the Lake Superior Region, whence comes about 85 per cent of the country's ore; (2) lies near the surface; and (3) is practically self-fluxing. At the present rate of consumption—6,000,000 tons *per annum*—this ore should last about 333 years (1924).

Coal

Birmingham gets its coal from the Warrior Field west of Birmingham Valley (Fig. 3), and in some cases from the valley itself. At Ensley, for instance, one sees coal being mined almost within a stone's throw of the coke ovens and blast furnaces.

This field has a reserve of about 3,333,000,000 tons, which should yield at least 2,000,000,000 tons of coke—enough to smelt the available ore, even if one-third of it should be used for purposes other than making coke. Moreover, the Cahaba Field, located east of Birmingham, contains coking coal, which, though not used for this purpose now, because it holds

slightly more volatile matter, yields less coke, and therefore makes costlier furnace fuel than that from the Warrior Field, is nevertheless a valuable future reserve.

Flux

Birmingham is unique in having an almost unlimited reserve of fluxing material right at hand. The quarries are located in the valley flats quite near the blast furnaces (Fig. 3).

Dolomite is used almost exclusively for fluxing at Birmingham because it has greater fluxing power; it is purer; it gives greater fluidity to the slag, thus enabling the furnace to run smooth and regular; it lowers the proportion of sulphur in the pig iron; and it has a more uniform composition. Some limestone is used in the open-hearth furnaces at Ensley.

BIRMINGHAM IN RELATION TO LABOR

Birmingham has the lowest labor costs in the country (Table III)—a situation that is consequent upon the lower wages paid its colored common laborers than are paid the unskilled workers in the two other districts. Since much more common than skilled labor is used, especially

in this district where three of the four producers specialize on pig iron, the average is greatly affected, despite the fact that the variation in wages between the highly skilled occupations in the three districts is slight. Birmingham's wages are low because living costs, especially clothing, fuel, and rentals, are appreciably less than in the colder climates of the North.

THE COST OF PRODUCTION AT PITTSBURGH, CHICAGO, AND BIRMINGHAM

The relation of each district to its raw materials has now been briefly presented. While Pittsburgh and Chicago are both well located for assembling one or two of their basic minerals, only Birmingham occupies the ideal site for total economical assembly. Embedded in a matrix of iron ore, coking coal, and fluxing dolomite, and lying in the center of the South with its cheap colored labor, Birmingham occupies one of the most strategic sites in the world for the manufacture of cheap iron and steel. Birmingham's indisputable advantages over its two great rivals both in assembly and production costs have already been presented in Tables I and II.

READJUSTMENTS IN POST-WAR COTTON CULTURE

Earl C. Case

Geographer, University of Cincinnati

COTTON culture and cotton manufacture, as now developed, are very largely the product of international trade. If this trade were suddenly interrupted, it would bring disaster to every important cotton-growing and cotton-manufacturing country in the world, and would menace the clothing supply of all peoples, from the savage wearing only the loin cloth to the fastidious metropolitan club man having a change of clothing for every occasion.

PLACE OF AMERICA IN THIS READJUSTMENT

Many countries, conscious that they depend upon foreign nations for cotton, cotton textile, or clothing, are putting forth strenuous efforts to make more secure their supplies and markets in these products. Their efforts are resulting in a decentralization of both cotton culture and cotton manufacture, and are stimulating international competition in both industries. To give a clearer understanding of the significance of the changes which are taking place it is best to set forth the conditions which are promoting keen international competition in cotton culture; to indicate some of the problems resulting from this international rivalry; to show the trends in the redistribution of cotton growing; and to indicate the bearing of these changing conditions on American cotton culture.

INTERNATIONAL TRADE AND COMPETITION IN THE COTTON INDUSTRY

Cotton culture and cotton manufacture afford excellent opportunities for the development of international trade and competition, and an overdevelopment in either industry within a given region may quickly result in depressing that industry 10,000 miles distant. Several factors have tended to bring these conditions about: (1) cotton and cotton products are classed as non-perishable and have large value per unit of goods; consequently, they can stand the necessary delays and expenses attendant on long-distance transportation; (2) the cotton crop of the world has mostly been fabricated in a few industrial centers widely separate from the restricted areas where it was grown; and (3) in turn, many of the important consuming areas were remote from the places of manufacture. These conditions have called for a tremendous amount of international trade in cotton and cotton textiles. As a result, cotton is, from the point of view of international trade, the most important among the products of the farm, and cotton textiles hold the same rank among the products of the factory. In 1920, cotton and cotton goods accounted for about one-sixth of the value of all international trade.

Much of the world's cotton crop crosses international boundary lines several times between the field and the ultimate consumer. For example,

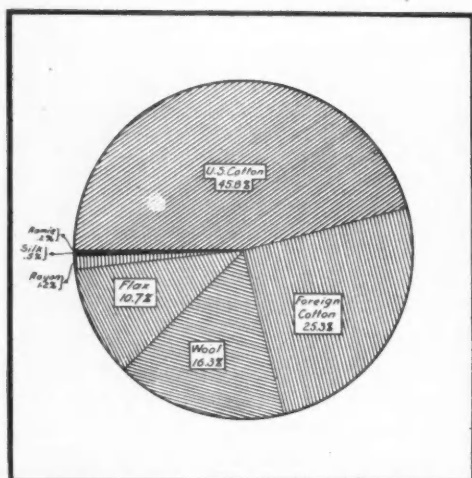


FIGURE 1.—World production of textile fibers, 1926-1927, is as follows:

| | (In Millions of Pounds) | |
|---------------------------------------|-------------------------|-----------------|
| U. S. Cotton .. | 8,591 | Rayon 220 |
| Foreign cotton .. | 4,793 | Silk 88* |
| Wool | 3,060 | Ramie 30† |
| Flax fiber used in making linen | 2,000 | |

* Not including silk consumed in China and Japan.

† Data for 1924-1925.

cotton grown in Egypt may be sent to Lancashire for spinning, bleaching, and mercerizing; then on to France or Belgium for weaving and thence to America for the manufacture of clothing. This international trade has become a major concern for every important cotton-textile producing country in the world and not one of them can disregard it without disastrous results to the industry.

REDISTRIBUTION OF WORLD COTTON CROP

Several factors are now working together to decentralize cotton culture and manufacture and to reduce the relative if not the actual value of the international trade; cotton is now being grown in ever-increasing quantities in countries which formerly depended almost entirely on America, India, or Egypt for their supply; the cotton-textile industry is being developed in almost every country in

the world, with the expectation that sooner or later local factories will supply most of the domestic needs; and tariff walls have been or are being erected by the principal textile-consuming countries to encourage sufficient home production to supply domestic markets. These developments are promoting a redistribution of both cotton culture and cotton-textile manufacture.

Clothing is considered among civilized peoples as one of the necessities of life, and much of the energies of mankind are spent in satisfying this need. The part the American Cotton Belt has played in clothing the human race is one of the industrial romances of the nineteenth century. More than 40 per cent of all the raw materials used for this purpose is produced in the southern part of the United States (Fig. 1). Is it any wonder, then, that to the South "Cotton is King?" This is an age, however, when kings are being humbled and perhaps, with the introduction of synthetic fiber, cotton may lose part of its former prestige, though it is likely to remain the leading textile material for an indefinite period.

While the cotton fiber may continue to hold unchallenged supremacy in the textile world, the case is not so clear for the continued dominance of the American Cotton Belt. For more than one hundred years this region, with but a small percentage of the world's potential cotton land, has produced from 50 to 65 per cent of the cotton used in clothing the nations of the earth. This proud position is being lost and the records 25 years hence may show a very different story. A study of the several factors involved leads to the belief that future development will

not be as steady or rapid in the United States as in other parts of the world.

It is a well-known law in economics that in order to avoid excessive loss there should be a spreading of the risk involved. The United Fruit Company, following this law, scattered its banana plantations in widely separated areas so that any single West Indian hurricane would destroy but a small part of the year's crop.

annum, whereas the non-American crop has held rather steady, and during the last six years has experienced a gradual increase (Fig. 2). The only considerable loss in any area, lasting longer than a year or two, is that of southwest Asia (Asiatic Russia, Turkey, and Persia), where the pre-war production of about 1,200,000 bales was almost wiped out. This loss is being recovered and has been more than offset by increases in

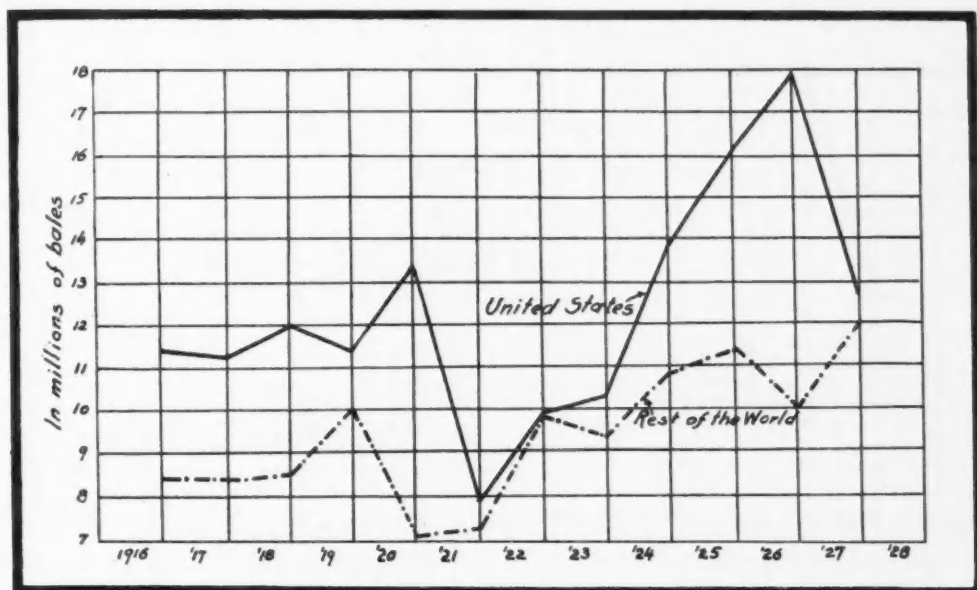


FIGURE 2.—Comparison of cotton production of the United States with the rest of the world.

The American Cotton Belt, however, is a compact area subject in its entirety to adverse conditions. The Mexican boll weevil, high-priced labor, or even unfavorable weather may strike with suddenness the entire region. The non-American cotton-growing areas, on the other hand, are widely scattered and the adverse conditions in some areas are offset by favorable conditions in others. As a result the American crop during the last ten years has varied from 8,000,000 to 16,000,000 bales per

other parts of the world. In fact, as is indicated in Figure 2, the non-American production of more than 10,000,000 bales during each of the last four years was greater than that for the United States during any one of the three preceding years, and it is only by good fortune that we have continually grown more than one-half of the world crop—a record which is likely to be lost with the first unfavorable cotton season in America.

Although the outlook is not bright

for increased production in America, many factors favor a steady and rapid growth in the development of non-American cotton culture. The acreage suitable for cotton is widespread and exceedingly large; the yield per acre in various regions is larger than that produced in America; and cheap labor, cheap land, and cheap animal power favor some of the newly developed countries. Moreover, several industrial nations are putting forth strenuous efforts to free themselves from dependence

PROBLEMS CONFRONTING THE COTTON GROWERS IN THE AMERICAN COTTON BELT

Although the American cotton crops of the last three years have been large, they have been produced under the stimulus of high prices, and by an exceptionally large increase in the area planted. From 1914 to 1921, inclusive, the area planted in cotton averaged only 35,194,000 acres; after which it steadily increased until in 1925 we planted 48,898,000

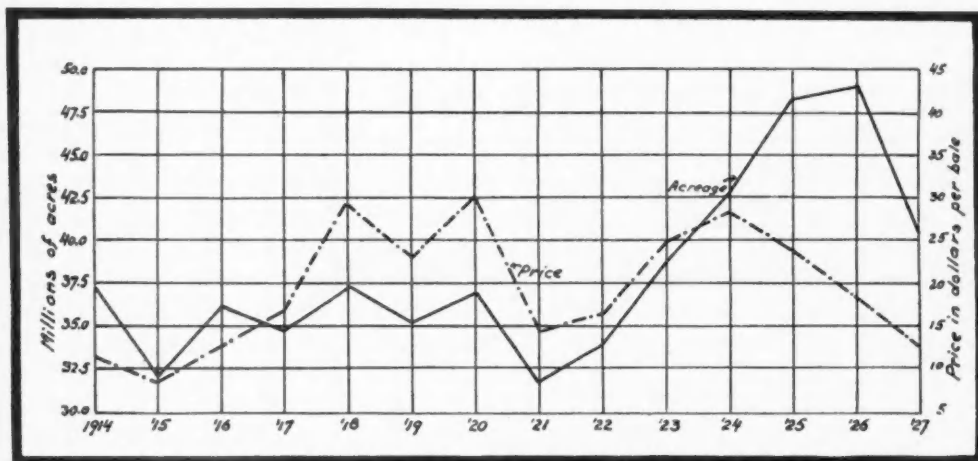


FIGURE 3.—Relation of cotton prices to acreage planted in the United States.

upon American cotton. A study of the success of their initial enterprises affords convincing arguments that America may never regain its former dominance in cotton production, and it seems very probable that its relative importance will continue to decline. This statement may seem pessimistic in the light of the American increase in production during the last three years, but the facts stand out more clearly when one considers in greater detail the present problems confronting the cotton growers of the South, and contrasts them with the advantages of growers in other parts of the world.

The low price of cotton during the planting season of 1927 caused a sharp decrease in the acreage given to this crop.

Although the acreage has increased, the production per acre has been declining steadily except for 1925, 1926, and 1927, when unusually favorable seasons have resulted in an increase. The average acreage production from 1904 to 1908, inclusive, was 193.8 pounds, whereas from 1921 to 1923, inclusive, the yield was but 132.2 pounds, increasing again to an average of 166.3 pounds during the four years 1925–1928, inclusive.

If the cotton production of the South does not decline it is necessary either to increase the acreage or to check the decrease in yield. It is scarcely to be desired that the area given to cotton be further increased or even that the present expanded acreage be maintained. Many parts



FIGURE 4.—Well developed cotton plants which produced no bolls due to the ravages of the boll weevil. (Courtesy of U. S. Department of Agriculture.)

of the South already show signs of serious depletion in soil fertility due primarily to the system of one-crop farming. There is already urgent need for a reorganization of farm practices in the Cotton Belt in order to restore soil fertility and to eliminate some of the hazards of this single-crop farming. The first step in this direction should be greater diversification of crops and a more extensive production of legumes; but such practices will tend to reduce the acreage planted to cotton.

There is no certainty that the downward trend in yield per acre has been checked more than temporarily. Labor shortage, boll weevil, and depletion of soil fertility are prime factors in the reduction of yield per acre. Due to a steady migration of the Cotton Belt negroes to the industrial centers of the North and East, there has developed an acute shortage of labor in the Cotton Belt. The extent of this exodus from the South is not accurately known, but it is estimated that more than 478,000 negroes migrated to the North during 1923. This movement, still under way, is especially unfortunate at a time when every effort should be made to combat the boll weevil. The prerequisites of cotton growing under weevil conditions are maintenance of the soil fertility, intensive cultivation, poisoning against the weevil, and fall destruction of stalks. These requirements cannot be met without an adequate labor supply. There is little indication that Southern labor will be cheaper in the near future. In fact it is to be hoped that cotton growers will be better paid. Their pay even with high-priced cotton is less than that received by any other large class of labor in the United States. "Cotton is produced by the help of hundreds of thousands of women and children who get a mere pittance for their labor. These women are not only the wives and daughters of negro hands, but also the wives and daughters of white tenant farmers and small farm owners. Many a cotton farmer's wife makes a regular 'hand' in the field during the planting and chopping season and again during the picking season, going to the house an hour or so early at noon and in the evening to

get the meal ready." It is probable that the competition between these laborers and the cheap labor of the Tropics may become greater rather than less. As a result the Cotton Belt is likely to turn more and more from cotton to the production of more profitable crops. It seems fair to assume, therefore, that the gradual decline in cotton yield scarcely can be permanently arrested until sufficient labor is available at reasonable prices, or until the acreage is de-

carried on in more than a dozen countries and in some cases with surprisingly successful results. Only a few of the more promising possibilities for expansion can be mentioned in this brief review.

COTTON CULTURE IN THE BRITISH EMPIRE

Great Britain has been the leading spirit in promoting the cultivation of cotton. The fear that she may not be able to obtain raw materials



FIGURE 5.—A negro family picking cotton in Alabama. The American cotton crop is picked by the help of hundreds of thousands of women and children who get a mere pittance for their labor. Yet, they are better paid than many laborers within the Tropics. (Courtesy of U. S. Department of Agriculture.)

creased and a better cropping system introduced.

The uncertainty of the future cotton production in the Cotton Belt, together with the increasing demand of American mills, has become a matter of international concern. The full significance of the problem can be understood only when one notes the world-wide interest shown in the development of the cotton-textile industry. As a result experimentation in cotton growing is being

for her Lancashire mills is a constant stimulus to further efforts in the promotion of cotton culture in various parts of the world, and especially in her own Empire.

COTTON CULTURE IN INDIA

The greatest development in India came before 1915, and thereafter the increase in production has been slight. After the war England began to turn her attention to other areas. The reason is not difficult to explain.

Most of the Indian cotton is very short staple and poorly suited to the needs of the Lancashire manufacturers. From the British point of view the prime necessity is to grow cotton with as long fiber as the best American upland staple, so that it may replace American cotton in the Lancashire mills. It seemed for a time that this could not be accomplished on any considerable scale in India, as the growing season in the principal cotton sections of India is too short for the proper maturing of types with long staple. In some areas the season is shortened by drought; in others, the crop must be matured early to escape insect pests, and in the irrigated districts of the North, where water is abundant and where pests cause the minimum loss, the season is cut short by frost. However, the English have again turned to India, this time with a conviction that they can produce high-grade cotton on a large scale.

During the last few years experimentation has proven that a good grade of cotton well suited to the needs of the British manufacturers can be produced in the central and lower Indus Valley—the Punjab and the Sind—provided water is supplied by irrigation. From 1915 to 1918 inclusive, the average Indus Valley production of long staple—15/16 to 1½ inches—was only 43,000 bales, whereas in 1924–25 it was 359,000 bales,¹ and during the same time the production of long-staple in all India had increased from 1,161,000 to 2,107,000 bales. This experimentation came largely as a result of the report (published in 1919) of the Indian Cotton Committee. Their

¹ The 1927 cotton crop of the Punjab and Sind exceeded 500,000 bales, practically all of which is long-staple.



FIGURE 6.—A machine that will pick more cotton in a day than can be picked by the eight laborers shown in Figure 5. Unfortunately the machine misses many bolls and picks some that are not entirely mature. If the mechanical cotton picker can be improved until it is as efficient as the machinery used in harvesting wheat, much of the drudgery of cotton picking will be eliminated and thousands of women and children will be freed from this hot and laborious task. (Courtesy of U. S. Department of Agriculture.)

views on the possibilities of cotton production in the Sind were summarized as follows: "Provided a perennial supply of water can be assured, we hold the view that there is no other part of India which offers such hopeful prospects of the successful cultivation of long-staple cotton. The climate and soil are in every way most suitable, and all that is wanted is water at the right time and in sufficient quantity." Though many difficulties had to be overcome, the water supply now seems assured and the desert area is soon to be turned into one of great productivity, affording the finest opportunities for the expansion of long staple cotton culture.

The area to be irrigated roughly coincides with the flood plains of the Lower Indus, and the water for irrigation is to be taken from that stream. The Indus River is an aggrading stream in its lower stretches and has built its bed above much of the surrounding area. The slope down from the river on either

side is sufficient to lead the water through canals to the plain by gravity. One is inclined to ask why this great area was not irrigated sooner. The answer is that the difficulties to be overcome were so great that the undertaking has had to await advancements in irrigation engineering.

The discharge of the river at Sukkar is nearly fifty times as great during the height of flood as at the time of minimum flow. The flow, moreover, is very uncertain, sometimes rising late, sometimes subsiding prematurely, and frequently it is unexpectedly reduced during the course of the flood season. Water for the irrigation of any considerable area is, therefore, extremely uncertain unless a dam be built to regulate the flow. The stream, however, meanders over a level plain and frequently changes its bed site through wide distances. As a result the greatest of engineering difficulties is the danger of diverting the river above the dam. This danger is to be overcome by constructing a barrage not as a solid dam, but as a series of arches which will remain open during the greatest flood season, but closed in time to store sufficient water to feed the canals.

It is believed that the present irrigation project overcomes the other major difficulty—the choking of the canals by sediment from the heavily silt-laden water and that it will provide an abundant supply of water at all seasons.

The plan as projected and started provides for the irrigation of 6,000,000 acres, an area larger than the total cultivated area of Egypt. It is expected that 2,000,000 acres will be given to the cultivation of long-staple cotton producing about 1,000,000 bales.

This region is already crossed by a railroad which connects it with Karachi. Neighboring regions can provide it with an abundance of labor already educated in the requirements for cotton production. It seems probable, therefore, that the land will be irrigated and put under cultivation very rapidly after the dam is completed.

Another irrigation project of the Indus Valley—the Sutly project—is expected to be completed within three years and should bring into cultivation 2,500,000 acres. These, together with other irrigation projects actually under construction, are expected to increase the total cotton area by more than 12,000,000 acres, most of which lies in the best cotton regions of India.

Unless these estimates are exceedingly optimistic, India may soon become a keen competitor with America as a source of cotton for English mills.

SUDAN GIVES GREAT PROMISE FOR COTTON CULTURE

India has by no means been the only place where the English have successfully fostered cotton culture. One of the most interesting and promising fields of operation is the Gezira Irrigation Project in the Anglo-Egyptian Sudan. The Gezira is a tract of about 5,000,000 acres of land lying near the junction of the Blue and White Niles. The British have just completed the Sennar Dam in the Blue Nile which will irrigate more than 300,000 acres. The eagerness with which the natives awaited the opportunity to cultivate this land shows something of the possibilities of rapid development here. In order to beat the floods of 1925, work had to be carried on con-

tinuously night and day, the night shift being lighted by countless 2,000 candle-power electric standards, which added a dramatic touch to an already fascinatingly interesting spectacle. The dam was completed in time to begin irrigation July 15, 1925. During the first season they were able to allot tenancy to 240,000 acres, of which 80,000 acres were actually planted to cotton. The results were most excellent. The 1927-1928 crop was 159,800 bales (400 pounds each) as compared with 50,000 bales in 1924-1925. It has been decided that cotton will be planted in three course rotation, that is, 100,000 of the 300,000 acres will be given to cotton each year. "The present plan provides for the irrigation of 3,000,000 acres by 1930, one-third of which will be planted to cotton each year, producing a fiber equal to the best Egyptian. It seems probable that the annual production of cotton fiber may reach 500,000 bales by 1930."

Another African territory—Uganda—has perhaps as great cotton-growing potentialities as the Gezira, and its present production is even greater. Uganda has now won for itself a secure and definite position among the cotton-growing areas of the world; it is producing nearly 200,000 bales of long-staple cotton annually, and can grow considerable more. The climate and soil are very favorable and insect pests cause no loss, although it would not be safe to count permanently on the absence of pests. It will not be difficult to increase the acreage, but sudden increase would intensify both labor and transport difficulties.

Other interesting experiments in cotton production are taking place within the British Empire, several of

which are showing most promising results, though they cannot be discussed in this brief review. It is significant to note, however, that the cotton crop of the British Empire exclusive of India increased from 82,220 bales in 1918-1919 to more than 400,000 bales in 1926-1927.

Although the cotton production of the British Empire is still small com-



FIGURE 7.—Picking cotton in Egypt. These laborers pick cotton for a few cents a day, and part of the crop is sold to American manufacturers in competition with American cotton. (Courtesy of U. S. Department of Agriculture.)

pared with that of the United States, nevertheless, the outlook is bright. The area in British territory suitable for cotton culture is large, and much of it will grow a high-grade, long-staple fiber suitable for European cotton mills. The principal handicaps are those of water supply, transportation facilities, insect pests, a labor supply educated to cotton production, and the time and energy that are required in suiting the types of cotton to the producing areas. These difficulties are being overcome slowly but surely in such widely separated areas as Punjab and the Sind, Anglo-Egyptian Sudan, Uganda, Rhodesia, South Africa, and Tanganyika. In view of the unceasing activities of the British Empire to stimulate cotton production,

it does not seem unreasonable that her efforts may be crowned with success to the extent that she may become independent of the American Cotton Belt or of other foreign areas for most of her cotton supply, and that she may even grow an increasing percentage of the cotton used in other European countries.

COTTON CULTURE IN SOUTH AMERICA

It is difficult to make more than a rational guess as to the rapidity with

A few conditions favoring expansion, however, stand out so vividly that they cannot escape the attention of one who studies the situation. South America has a larger acreage suitable to cotton culture than that available in any other continent. Brazil, Peru, Argentina, Paraguay, Venezuela, Colombia, and Ecuador each have potential cotton areas.

Brazil, however, seems to afford opportunity for the most rapid expansion. The fundamental conditions which favor Brazil are: (1) A



FIGURE 8.—Cotton grown in northwest India from American seed. The yield on irrigated land is about 250 pounds of long-staple cotton per acre. Unirrigated land within the same area produces but 60 or 70 pounds of short-staple cotton per acre during seasonable years. (Courtesy of U. S. Department of Agriculture.)

which cotton culture will increase in South America. Many of the problems to be solved are the same as those faced by the British Empire. The development is closely tied up with the control of insect pests; the success in adapting types of cotton to producing areas; the procuring of a labor supply acquainted with the needs of cotton culture; the price of cotton and the amount of export duties levied on the fiber; and the aid and encouragement given to cotton culture by foreign powers such as Great Britain, Japan, and Italy.

very large potential cotton-growing area estimated at more than 75,000,000 acres; (2) a climate which is generally favorable; and (3) suitable soil. Credence is lent to the large acreage estimate by the fact that fifteen of the eighteen states of Brazil are already producing cotton in commercial quantities. The existence of suitable soil and climate is evidenced by the high yields, particularly in the state of São Paulo, where as much as 890 pounds of lint cotton to the acre are said to have been obtained, and where the yield per acre is greater

than that in the United States, averaging 175 pounds of lint in 1923-1924 against 132 pounds in this country. Moreover, the bulk of the cotton grown in Brazil is long-staple comparing favorably with the best American upland cotton.

It is useless in a brief review to attempt estimates of potential cotton acreage in other South American countries except to say that it is large—out of all proportion to the needs of growing cotton. The limiting factors will not be exhaustion of available land with suitable climate and soil, but some or all of the limiting factors mentioned on page 10.

From Argentina experts in cotton growing send out conflicting reports concerning the probable development in the immediate future, but they express unanimity in the belief that the hindrances to development are of a temporary nature. The advantages and disadvantages are perhaps summarized as briefly and concisely as possible in the following reports, and the trend in development is shown in Table I.

TABLE I
PRODUCTION OF COTTON IN ARGENTINA

| Year | Acres | Bales of 400 lbs. each |
|----------------|---------|------------------------|
| 1921-1922..... | 39,000 | 17,282 |
| 1922-1923..... | 57,250 | 26,892 |
| 1923-1924..... | 156,750 | 73,703 |
| 1924-1925..... | 262,500 | 67,000 |
| 1925-1926..... | 275,000 | 68,400 |
| 1926-1927..... | | 129,000* |

*Estimated.

"Argentina has 96,000,000 acres suited to cotton culture, but development will probably be slow. The leading drawbacks to the extensive cultivation of cotton in Argentina are: lack of adequate transportation facilities in the sections cultivated; an inadequate supply of labor; uncombated diseases, and the pests of locusts, ants, and caterpillars; the enslavement of the peon and the

farmer through the system of compulsory trading with the country stores of employers; and the dependence of the producer for the sale of his crop on grasping speculators. At the same time it can be readily seen that all of these disadvantages are capable of easy correction."²

To the casual reader the mere statement that these disadvantages are easily overcome does not seem convincing. However, these difficulties are being overcome, as is indicated in a late report from Mr. Tutt, the American expert who has been investigating conditions in Argentina, who says: "The cost of cotton production there (in Argentina) is lower than in the United States, owing to cheaper lands, cheaper animals for power, cheaper labor, and larger yield per acre."³

With the preceding facts in mind, perhaps one may be better able to draw conclusions as to the future of cotton culture by a study of the trends in production during the last five years. It is well to note that the largest acreage was planted when cotton prices were low and after they had harvested the poorest crop grown in years. If under such circumstances, they are encouraged to increase the acreage, their chances for success seem bright.

In spite of the many pessimistic forecasts concerning cotton production in South American countries there has been a steady expansion and improvement which one may reasonably expect to be continued. The handicaps are not for the most part basic, but are such as might be

² Report of American Consulate at Buenos Aires to the U. S. Bureau of Foreign Commerce, Textile Division, August 2, 1921.

³ "Argentina's Need for Population," *The Times Trade and Engineering Supplement*, Sept. 26, 1925.

expected to exist for a time in slightly developed regions. The rapidity with which these difficulties may be overcome depends largely on the price of cotton, on the encouragement of cotton culture by South American countries, and on the efforts of various industrial countries to insure a cotton supply for their own mills by fostering cotton culture in the newly developed portions of South America.

methods of agriculture and poorly selected types of cotton rather than to fundamental defects of soil or climate. If systematic efforts were made by the Chinese Government or by powerful textile organizations to improve the cotton culture, there is little doubt that China would become an outstanding factor in the world cotton situation. The Chinese farmers are conservative, and one must



FIGURE 9.—Cotton piled near the seashore at Bombay ready for shipment to England, Japan, and other textile manufacturing countries. (Courtesy of U. S. Department of Agriculture.)

COTTON CULTURE IN CHINA

In a consideration of potential cotton land China must not be omitted. Fundamental conditions such as soil, climate, labor supply, and markets favor increased production, and the area suitable to cotton culture is perhaps as large as the American Cotton Belt. The total area under cotton cultivation is unknown, but it is believed that it could be increased enormously, and that much of the former poppy-land could be devoted to it if there were sufficient increase in demand. Much of the cotton is of very short staple, but this is largely due to backward

not expect these changes to take place very rapidly. Nevertheless, the increasing importance of the Chinese cotton-textile industry is creating a need for more cotton, and at the same time is developing an organization that will be effective in the extension and improvement of cotton culture.

COTTON CULTURE FOSTERED BY INDUSTRIAL NATIONS

The textile interests in Japan, Great Britain, and Italy are all persistent in their efforts to promote cotton culture. Japan is showing great interest at this time. The meteoric development of her textile

industry gives her third place in cotton consumption, among the nations of the world. Most of her supply is imported from India, and the finished products are being sold in competition with Indian textiles. As a result, the Indian Government is considering the necessity of placing an export duty on raw cotton in order to save her own textile industry. This act would seriously menace the Japanese textile industry as conducted at the present time. To forestall such a disaster, the Japanese are earnestly endeavoring to promote cotton culture in other parts of the world and especially in Brazil, Peru, and Chosen. In the belief that Brazil affords opportunity for large-scale production, the Japanese spinning companies have appropriated funds with which to send experts to Brazil to investigate the possibilities of establishing large cotton plantations there. It is hoped thus to provide cotton for Japanese mills and at the same time an outlet for Japanese colonists.

The expansion of cotton culture is being given new impetus by the spread of the cotton-textile manufacture to newly developed centers. The two industries are so closely related that changes in one are quickly noted in the other. To give some idea of the importance of such inter-relationship it is only necessary to cite a few illustrations. The threat of a textile trade war between Japan

and India stimulates the Japanese manufacturers to greater efforts in providing a cotton supply which will make them independent of Indian growers. Indications of restricted cotton production in Egypt may cause immediate concern among many American and European manufacturers who are spurred on to greater efforts to promote the cultivation of "Egyptian Cotton" in other regions. The growing cotton-textile industry of America, Brazil, India, and other cotton-growing countries threatens to leave little for export and is a cause for anxiety among the textile manufacturing nations which do not grow cotton. As a result they are promoting cotton culture in many parts of the world in an effort to make secure a cotton supply for their own mills. All these factors are tending to promote a widespread distribution of cotton culture with greatest attention being given to under-developed areas of South America, Africa, and Asia. As a result the American Cotton Belt is in danger of losing some of its eminence in cotton culture and as the prime producer of raw materials with which to clothe the human race. This loss may be an economic gain for both the Cotton Belt and the remainder of the world provided proper adjustments are made in the agricultural development of the South while these changes are taking place.

TUNG OIL: FLORIDA'S INFANT INDUSTRY*

M. Ogden Phillips

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AN industry centuries old in China may soon be forced to yield its hold upon the American market to an infant competitor in Florida. The United States, like the whole world, depends upon China for its supply of tung oil. Each year American paint and varnish manufacturers pay from \$10,000,000 to \$15,000,000 to Chinese producers of tung oil. It is hoped that this complete dependence upon a single source of supply will be broken before long by the efforts of Florida growers of the tung oil tree.

USES OF TUNG OIL

The uses of tung oil are interesting. For centuries Chinese ships have been calked and painted with tung oil. Over 600 years ago Marco Polo, the great Venetian traveler, wrote, "They take some lime and chopped hemp, and these they knead together with a certain wood oil; and when the three are thoroughly amalgamated they hold like any glue, and with this mixture they pay their ships." This practice of calking ships with the same combination of materials is as common today as it was in the days of Marco Polo. The unusually smooth and weather-resistant exterior finish on Chinese junks has also long been admired by foreign sailors. Furniture and articles of fine wood are finished with lacquer varnish containing tung oil, which causes the varnish to dry much

faster and which renders a highly protective finish. The oil serves as an ingredient for dressing leather and for making soap, linoleum, and medicines. In interior China it is used to some extent for illuminating purposes, although the light which it furnishes is smoky and unsatisfactory. When the oil is burned to a soot, the finely divided carbon serves as a basis for the manufacture of indelible ink. Silk and paper are waterproofed by tung oil which has been heated and mixed with certain mineral substances. Its various and specific uses are almost innumerable, but its principal use is for waterproofing wood and other materials which the Chinese wish to protect against the weather. In timber-poor China this effort of men to prolong the life of wood and paper represents an interesting adjustment to the environment of the region.

In the United States tung oil is almost invaluable for the production of high-grade paints and varnishes. The oil is combined with southern rosin and other substances to make spar varnish, which is superior to the older and more expensive copal varnish. Spar varnish represents the acme of perfection among varnishes today. Nearly every one has seen the advertisements showing boiling water being poured from a tea kettle upon wood which was protected by spar varnish. And, as advertised, no whitening or softening of the protective varnish film results from such treatment. Tung oil is also combined with zinc, manganese, lead,

*The author is indebted to Mr. B. F. Williamson, commercial tung oil expert of Gainesville, Florida, for the photographs and for much of the material used in this article.

or cobalt to form tungates, which serve as ingredients in paint driers. Aluminum tungate, formed by a combination of aluminum oxide and tung oil, is used to protect materials against fire and water. Tung oil has largely replaced linseed oil in the making of enamel, oil cloth, and linoleum; and it is especially important in the manufacture of high-grade floor, wall, and deck paints.

CHINESE TUNG OIL TREE

Tung oil of commerce is obtained from the fruit of the tung oil tree (*Aleurites fordii*), which is known in China as the tung-yu-shu tree. The name "tung," which means heart, has been applied to the tree because of its heart-shaped leaves. It is indigenous to the central and western parts of China, most of the trees for commercial production being grown in the provinces of Szechwan, Hunan, Hupeh, Kweichow, and Kwangsi. Closely allied to this tree is the China wood oil tree (*Aleurites montana*), or mu-yu-shu tree, a native of southern China, the fruit of which yields an oil which is substantially the same as tung oil, at least as far as commercial uses are concerned. The two oils are frequently mixed for export. The China wood oil tree requires warmer temperature and greater rainfall than the tung oil tree, and its production has been less extensively exploited. Over 90 per cent of the wood oil which enters into world trade is the product of the tung oil tree. Before discussing the Florida tung oil industry it may be of interest to describe conditions which surround the Chinese industry.

CHINESE METHODS OF PRODUCTION

In China the tung oil nuts are knocked off the trees with bamboo

poles before the nuts are mature. The husks are loosened by piling the nuts where they will be exposed to the weather. This process of harvesting before maturity and subsequent fermentation is unnecessary and is harmful to the quality of the pressed oil. Sometimes the husks are removed by dropping the nuts into boiling water. The seeds are picked out by hand and are taken to the local mill, where they are cleaned by a simple fanning mill or by hand. Then follows the drying process, which may be achieved by drying the seeds in the sun or by roasting them over a fire or in a kiln. The effect of fermentation and parching the seeds some time before pressing occurs is bad, because the enzymes of the seeds begin to act upon the oil and the natural pigment. The oil which is subsequently extracted is darker in color and contains much acid and is therefore lower in quality.

The seeds are then pulverized in a primitive mill, which may consist of only a log used as a hammer and operated by a coolie. The pulverized mass is cooked in vats, and a certain amount of water is added. Straw is also added, and the mass is then shaped into cakes, which are about 4 inches thick and 15 to 18 inches in diameter. The cakes are taken to the native press, where the oil is extracted. The straw serves to prevent the paste from being squeezed out with the oil. The presses are extremely crude and have not changed in style for centuries.

The oil extracted by the native presses is strained and poured into bamboo baskets, which are lined and covered with layers of varnished paper. Each basket holds from 120 to 380 pounds of oil, and they are suspended from a pole carried by

two coolies. The coolies carry them to the nearest stream, where they are loaded on junks bound for Hankow. Each junk carries from 300 to 750 baskets of oil worth nearly \$10,000. The passage through the rapids of the Yangtze River is dangerous, and marine insurance rates are often as high as 20 per cent. Although many cargoes are lost, the Junkmen's Union has thus far succeeded in preventing

cial importance to the paint and varnish industry of this country. Patently the methods of the Chinese are crude, wasteful, and result in unnecessarily high prices to foreign consumers. The oil passes through many hands before it even reaches the banks of the Yangtze River, and much adulteration takes place. Little oil is exported from China that does not contain some peanut, soya, stil-

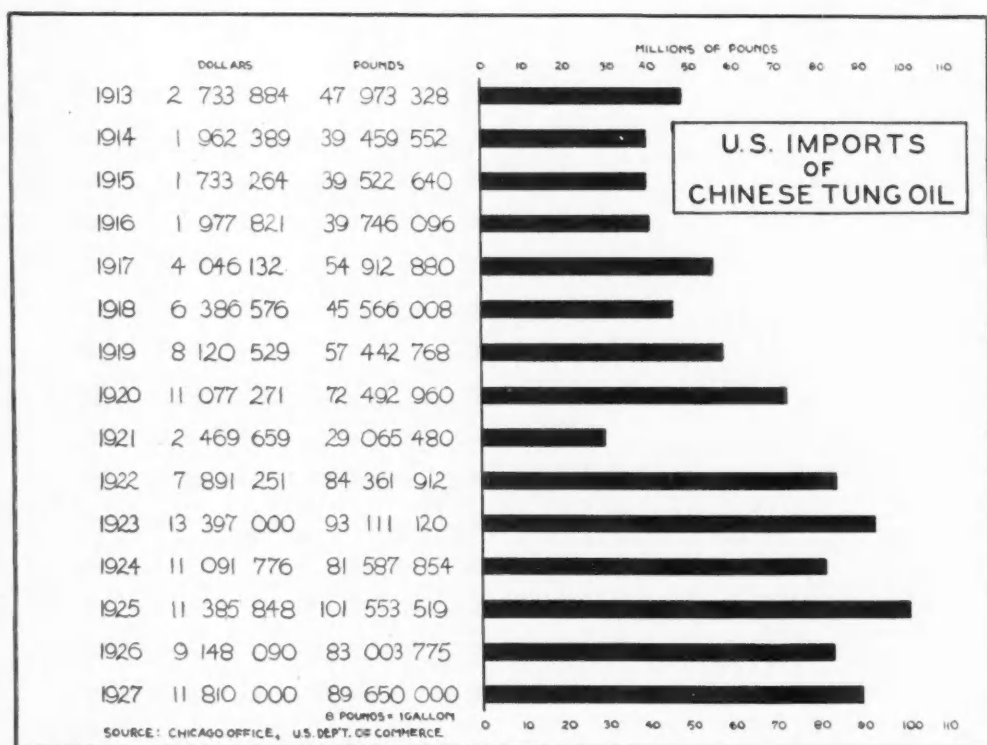


FIGURE 1.—United States imports of Chinese tung oil.

the use of river steamers in the trade. At the warehouses in Hankow the oil is dumped into large settling tanks, and the dirty residue is removed. The clear tung oil is finally exported in tank steamers.

Although wood oil was exported from China to the United States as early as 1869, it has been only since the beginning of the twentieth century that the oil has been of commer-

lingia, sesame, or other low-grade oil. Chinese tung oil frequently runs from 5 to 8 per cent acid, and the quality is so uncertain that no manufacturer will accept a shipload without tests. The Chinese have constantly refused to change or improve their methods.

Furthermore, in crowded China, where the man-land ratio is high, only the soils poorly suited for food crops

can be planted in tung oil trees, and there seems to be little possibility for any considerable extension of the industry. The apparent limitation of supply coupled with an increasing demand resulting in higher prices, the uncertainty of supply from time to time, the effects of crude and wasteful methods of production, the practice of adulteration,—such conditions as these have led American interests to promote the culture of tung oil trees in this country.

EXPERIMENTATION IN THE UNITED STATES

Over twenty years ago the government realized the gravity of the situation and sent agricultural explorers to investigate the tung oil industry in China. The best seeds from healthy trees were procured, and young trees were propagated and distributed to state experiment stations from California to Florida and as far north as the Carolinas. After many years of experimentation throughout the country, the conclusion has been reached that tung oil trees attain their best growth and maximum yield in the vicinity of Gainesville, Florida. The first tung oil trees in Florida were planted in November of 1906 in Tallahassee, and in 1913 a bushel of tung oil seeds were shipped to the Paint Manufacturers' Association of Gillsboro, New Jersey. From these seeds were extracted 2.2 gallons of oil, the first tung oil produced on the American continent.

CLIMATIC AND SOIL REQUIREMENTS

The climatic and soil requirements of the tung oil tree are major factors which determine the location of the industry. While the tung oil tree is more hardy than citrus trees, com-

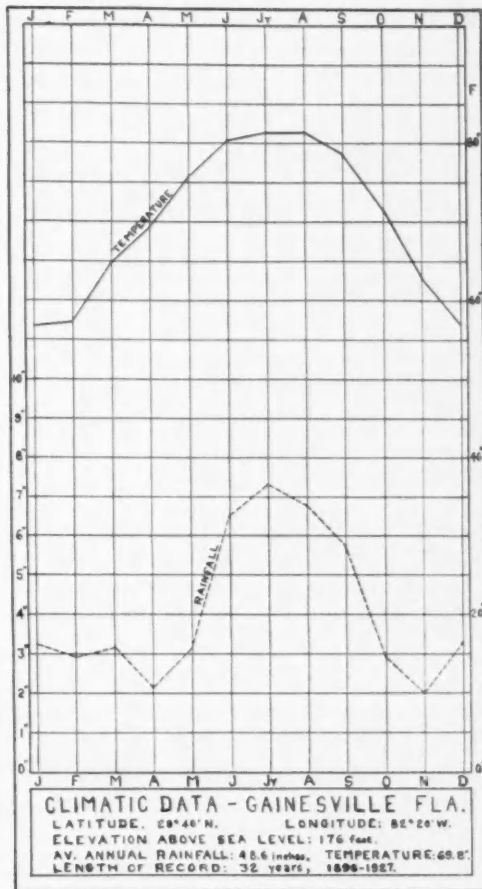


FIGURE 2.—Temperature and rainfall at Gainesville, Florida.

mercial plantings run a serious hazard if the temperature drops below 18 or 20 degrees Fahrenheit. Although mature trees may stand lower temperatures, a sudden drop to 18 or 20 degrees is quite likely to kill the young trees. At Gainesville, which is in the heart of the Florida tung oil area, the mean annual temperature is about 70 degrees. On only nine days in forty years has the temperature been known to fall below 16 degrees.

A mean annual rainfall of 28 or 30 inches is the minimum requirement for tung oil trees, but optimum results are obtained from an annual

rainfall of 40 to 50 inches. Gainesville has a mean annual precipitation of 48.66 inches. Highly significant is the requirement that the maximum precipitation shall occur in the summer months. In the months of June to September inclusive, Gainesville has a mean monthly precipitation of 6.56 inches, and the temperature averages about 80 degrees.

During the drier months of spring, young tung oil seedlings are easily injured by drying winds. Consequently, the young trees require special attention throughout the period of early growth.

In Florida tung oil trees prefer an acid soil, and soft limestone within the reach of roots must be avoided. Good drainage is very essential. The trees grow best in a deep light soil well supplied with organic matter. The nutrient content of the soil is a major factor affecting yields, and this, fortunately, is within the control of man.

NO SERIOUS DISEASES OR INSECT PESTS

Survival of the fittest through centuries has produced a healthy tree in China, and only seeds of the healthiest and most prolific trees were brought to this country to start the industry here. As a result of this precaution and constant effort in tree selection, tung oil trees in Florida have been practically free from the ravages of diseases and insect pests. A few of these may be worthy of mention.

Young trees are sometimes attacked by root knot, the cottony cushion scale, or the latania scale, but these diseases are easily controlled. The only important disease which affects Florida tung oil trees is chlorosis. This causes the leaves

to lose part or all of their coloring matter, and the disease may proceed so far as to kill the tree. It may be alleviated by the application of stable manure or commercial aluminum sulphate. The disease is caused by an excess of lime in the soil. This shows the importance of making a few soil tests before a grove site is selected. The southern lubber grass-



FIGURE 3.—A tung oil nursery near Gainesville, Florida.

hopper with its love for tender foliage is a pest which sometimes appears in young groves, but most farmers know that this enemy can be routed by spraying with lead arsenate. However, the damage done by grasshoppers in Florida groves to date has been so insignificant that it has not even been worth while to combat these insects with spray or poison.

AMERICAN METHODS OF CULTIVATION

In Florida young trees are grown in a great outdoor nursery and are then transplanted in the prospective grove, which has been deeply and carefully plowed. The young trees are planted methodically in 30-foot rows at a distance of $12\frac{1}{2}$ feet between trees with the object in view

that every other tree shall be removed when crowding of the mature trees becomes apparent seven or eight years later. About 116 trees are planted to the acre. It is a general practice to plant tung oil seedlings in December and January, when the trees are most dormant; this permits the young trees to become well established by late spring, when the drier months occur.

A system of cover crops is quite essential. Rye or oats may be planted between rows in the fall and some such crop as Brabham cow peas, velvet beans, crotalaria, or beggarweed in early summer. These cover crops protect the young trees against drying winds and later make possible green fertilization, which plays an important part in maintaining the humus content of the soil so necessary for good yields of tung oil fruit.

Florida soil needs nitrogen, and at times throughout the spring and summer mixed guano and nitrate of soda are applied. It has been found especially profitable to apply nitrate of soda to the land about three weeks before blooming time because of the stimulating effect which it has upon the yield of fruit.

During the dry season from March to May, the middle area between rows is given shallow cultivation. This is a period when clean cultivation is necessary so that the trees may obtain all moisture possible. Three small tractors pulling disc harrows can cultivate 100 acres per day.

Considerable pruning is required at planting time. It is the aim of growers to produce a low-headed tree which possesses lateral branches. A low-headed tree can be more easily attended to, it is an earlier and heavier bearer, and it is less liable to wind damage. After the tree is definitely



FIGURE 4.—A five-year-old tung oil tree in a Florida grove.

shaped no further pruning is necessary except to cut away water shoots and dead branches.

At the age of three years tung oil trees begin to produce fruit, or nuts as they are commonly called, and in their fourth year the production is commercially important. In Florida the nuts drop off the trees in the dry months of October and November, and, because of the hard protective husks, they may be permitted to lie upon the ground for several weeks until it is convenient to gather them. Harvesting is a very simple process, a mere matter of gathering the nuts and storing them in some dry place.

EXTRACTING PROCESS

In Florida the tung oil nuts are husked by a mechanical decorticator. Each nut contains five or more seeds, which constitute about 50 per cent of the total weight of the

fruit. After the seeds are thoroughly dry and have been cleaned by a fanning mill, they are ready for grinding and pressing. Gainesville, Florida, situated at the intersection of two major railroads and in the midst of the tung oil area is the natural milling center.

The technique developed by American producers for extracting the oil from the seeds is far superior to that of the Chinese. In the first place, the crude type of wooden hand press used in China obtains only 75 per cent of the oil from the seeds, while the efficient Anderson expeller used by Florida producers extracts at least 96 per cent of the oil from the material handled. In the second place, in China the seed coats are picked off by hand before the seeds, or kernels, go into the press, while in Florida the seeds are merely cracked and are pressed whole without removing the seed coats. Consequently, more oil is available to American producers. In the third place, under American methods the seeds are heated only once before the pressing occurs. They are not heated to high temperatures, as in China, but only sufficiently to make the oil flow readily, and the heat is applied just before the seeds enter the press. As a result, American tung oil is low in acid content and light in color; it is therefore of higher quality than the Chinese product. It was not until this truly prime tung oil was produced under American methods that the inferiority of the Chinese product was fully realized.

YIELDS

Satisfactory results have been by no means confined to the extracting end of the industry. The use of



FIGURE 5.—Tung oil nuts grown in Florida.

proper methods of tree selection, cultivation, pruning, and fertilization have proved their worth. Mr. B. F. Williamson, commercial tung oil expert of Gainesville, Florida, reports that in 1927 there were in Florida tung oil trees only three and a half years old which had produced over 300 nuts per tree in contrast with 130 nuts taken from a tree over ten years old located in one of the best groves in China. In the same year an acre of 109 trees near Gainesville produced tung oil nuts yielding 1,020 pounds of oil and 1,930 pounds of residue. Certain individual trees have produced as much as four gallons (32 pounds) of oil in a single year. It is expected that nine-year-old trees in Florida will average at least 30 pounds of oil per tree annually.

HIGH CROP VALUE PER ACRE

The crop value per acre is indeed high. An acre of 116 trees, which

are five years old, produce normally 116 bushels of unhulled tung oil nuts yielding 5.6 pounds of oil per tree. Thus, when tung oil sells at 15 cents per pound, the crop value per acre of a grove of five-year-old trees is \$97.44. A seven-year-old tree yields

cereal or fruit crops can compare with tung oil in value per acre.

TUNG OIL VS. LINSEED OIL

Although linseed oil is at the present time the backbone of the paint and varnish industry, the increasing demand for tung oil makes the future of linseed oil appear precarious. A comparison between these two competing oils is of interest. The peculiar qualities of tung oil make it superior to linseed oil and tend to give it a higher market value. The maximum yield per acre of oil from flaxseed is only 255 pounds, while the yield from an acre of nine-year-old tung oil trees is 1,800 pounds. Because of its susceptibility to disease when grown continuously on the same land, flax is generally produced on new lands; it is considered by American farmers to be quite hard on the soil. Flax must be harvested promptly when mature and, like wheat, requires expensive harvesting machinery. Tung oil nuts can be left on the ground for weeks during the dry months of October and November in Florida and then be gathered at the convenience of the grower. Flax culture requires plow agriculture and invites erosion of the soil; tung oil, a tree crop, retards erosion. Flax is an annual crop planted every year. Tung oil trees are planted but once, and they continue to bear for 25 or 30 years.

DANGER OF OVERPRODUCTION?

One of the chief economic problems which confronts Florida growers is the task of producing a large enough supply of tung oil. At the present time in China a virtual "sellers' market" prevails. A large order for 5,000 tons of oil is more apt to send the price up than it is to be accorded



FIGURE 6.—A part of the 1927 crop of Florida tung oil nuts.

about 17.6 pounds of oil, and the crop value per acre is \$306.24. At the end of the eighth year every alternate tree is usually removed, leaving approximately 60 trees per acre. A nine-year-old tree yields 30 pounds of oil per tree, and the value of the crop per acre is \$270. From this time on the yield increases appreciably. If a more conservative price basis of 10 cents per pound were used in calculating crop values, the above mentioned values should be decreased by one-third, but if the present price of 20 cents per pound continues to prevail these values should be increased by one-third. Certainly few

the usual discount given to large orders. The problem of the Florida producers is to grow enough trees to assure American paint and varnish manufacturers of an adequate and dependable supply of oil. Furthermore, tung oil at the present time is used only in the manufacture of the higher grades of paints and varnishes. Because of its superior peculiar qualities tung oil would undoubtedly supplant linseed oil and would be much more generally used, if there were a large enough supply. The danger of "overproduction" is indeed remote.

PROBLEM OF JOINT PRODUCTION

Another economic question is the problem of joint production. It was mentioned above that from an acre of trees 1,930 pounds of residue were recovered from the tung oil nuts in addition to the 1,020 pounds of oil. This residue constitutes a good fertilizer, testing about 5 per cent ammonia with a trace of potash and phosphorus. This joint product will undoubtedly possess a marketable value as production increases.

When the uses of cotton seed were discovered, the production of cotton was materially increased, and a lower price for cotton fiber resulted; however, the farmers received a greater aggregate net return from the two products than from just one. The respective prices obtained for joint products are determined primarily by the relative intensity of demand. In the case of tung oil and its fertilizer residue it is not expected that the sale of the by-product will depress the price of the tung oil, because the demand for this fertilizer will not be particularly intense in view of the available supplies of cheap nitrate, which is now sold on the Ameri-

can market. However, the price received for the fertilizer residue will undoubtedly more than cover the extra separable costs involved in handling the product and will add to the profit received by the tung oil producers.

MENACE OF CHEAP CHINESE LABOR?

An economic bugaboo is the question of competition with cheap Chinese labor. In the case of rice, which requires much more labor than a tree crop like tung oil, one laborer in China can handle only one-half to two and one-half acres, whereas in Louisiana and Texas, with the use of large-scale production methods and modern machinery, the number of acres handled per laborer is 80. The labor cost per acre for growing rice in Louisiana and Texas is one-half of the labor cost in China.

Even though the Chinese laborers receive a money wage of only 15 cents per day, there is every reason to believe that Florida costs of production will continue to be lower than Chinese costs. One of our huge presses does the work of more than 90 to 100 Chinamen operating the crude wooden hand presses. Even though our wages and freight rates may be high, transportation on the backs of Chinese coolies plus the river haul with its high insurance rates is said to cost from five to seven times as much per mile as transportation in America. Raw land suitable for tung oil trees in Florida sells at \$20 to \$30 per acre. The use of tractors in cultivation is another advantage which reduces the American cost per acre. Obviously the danger from Chinese low wages is a myth.

Furthermore, there is an economic law which states, "A country tends

to export those products which are produced at a lower comparative cost than elsewhere," and if Florida producers continue to maintain and to capitalize their advantages, it is conceivable that the American tung oil industry may eventually shift from an import to an export basis.

THE SITUATION TODAY

What is the situation in Florida today? According to Mr. B. F. Williamson, an approximate census of tung oil trees planted in Florida reveals the following increase: 1923, 14,000 trees; 1924, 39,000 trees; 1925, 102,000 trees; 1926, 200,000 trees; 1927, 300,000 trees; 1928, 400,000 trees. More than 100,000 new trees were planted during the winter of 1928-1929. In the fall of

1928 over 160,000 tung oil trees had entered commercial production. So Florida's infant industry is getting a healthy start.

The tung oil industry is replete with geographic interest. The future inter-regional relationships between an area in China which has been producing tung oil for centuries and a newly developed section in north central Florida can only be conjectural. It is apparent, however, that the tung oil tree growers of north central Florida are critically utilizing the soil and the humid subtropical climate of their area with typically American methods of production. This interesting economic adjustment to the environment of the region seems to hold promise of profit and success.

THE FARM PROBLEM

Robert Stewart

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JOHN J. RASKOB, Chairman of the Democratic National Committee, is reported in the news dispatches to have said, "The East has never understood the farm problem." The farm problem can be stated very simply. According to the census of 1920 there are 41,614,248 persons over ten years of age engaged in gainful occupations, and of this number 10,953,158 are employed in agriculture. Twenty-six and three-tenths per cent of those who are working for a living are engaged in agricultural pursuits and they receive thirteen and eight-tenths per cent of the national income. The farm problem is simply this: How can the agricultural workers secure a fairer share of the national income?

The causes which have operated to place the agricultural worker in this unfavorable position are numerous, and there is no simple solution for his difficulty. Before a solution can be attempted a clear conception must be obtained regarding the factors which have operated or are operating against the farmer in the economic scheme of things.

While the agricultural problem has become more acute during the past eight years, it is really of much longer duration. The agricultural worker has never been on a parity with the worker in other lines of industry. In 1850, 44 per cent of those gainfully employed were in agriculture and received only 34.6 per cent of the national income. It is no wonder that the Institute of Social and Religious Research in a recent report

says: "Discontent is widespread among rural population. As to its cause, opinions differ, but the fact remains that rural life is not yielding the relative satisfaction it once gave."

What are the causes which have operated to place the farmer at such a disadvantage with respect to other workers and to cause such discontent?

THE GOVERNMENTAL LAND POLICY

A factor of vital importance in this connection and one usually not understood or emphasized is the land policy of the national government. The national government once controlled vast quantities of virgin land. This land has been disposed of rapidly and handed out with a generous hand. Land was given away for railroad construction, in support of schools, and to investors and individuals. Homestead laws were passed making it easy for citizens to secure land. Soldiers were paid in *script* which could be redeemed in land.

This resulted in a wild orgy of land speculation. Land was rapidly developed in the West. Crops were produced on the basis of the speculative value of land rather than on the business conception of an industry for the production of a necessary commodity. Food in the cities was cheap because it was produced on free land or the open range. This policy has been a vital factor in making possible the building of our large cities.

The aftermath of this policy is now

being reaped by the present generation of farmers. Land now has a definite value. It is true that the late war created a fictitious value in many cases. The era of land speculation, however, is now at an end. Food commodities must be produced on an efficient basis. Land must now be regarded as a definite factor which must be considered in the cost of producing crops.

under cultivation. The history of the government reclamation projects is pertinent in this respect. Twenty-three years after the inception of the government reclamation policy it was found that one-fifteenth of the land it was proposed to reclaim was permanently unproductive and one-seventh was temporarily unproductive and could only be reclaimed at additional great expense. That is, one-fifth of



FIGURE 1.—Mechanized farming; plowing with tractors in the Great Plains Region. (Courtesy of International Harvester Company.)

Too many farmers are trying to farm poor land. The land policies of the government in the past have brought under cultivation much marginal land which is incapable of economic crop production. Much good grazing land has been broken up and converted into mediocre wheat land when the yield of wheat is only nine to twelve bushels per acre. As a result of this governmental policy of land disposal, good grazing land has been spoiled to make poor crop land.

Alkali lands unsuited for crop production or which can only be reclaimed at a high cost have, under government sanction, been brought

the total land under government irrigation was incapable of producing crops economically.

Similar conditions exist in the Middle West, the East, and the South, although the causes which produce the marginal land are different. For example, much of the hill lands of New England, New York, and Pennsylvania should never have been brought under the plow. Such land now should be allowed to revert to pasture and forest land for which it is ideally adapted. Some means should be devised for allowing this type of land to revert to pasture or forest.

Forestry offers an important ave-

nue for government assistance to agriculture. Much of the land now being farmed is marginal land which produces poor crops at a high cost of production. Such crops are produced without profit to the producer and only add to the total surplus which depresses prices for the efficient producer.

The influence of the land policy on the agricultural situation is a far

What is really needed is the establishment of a sane and far-reaching policy of land utilization. The entire land area of the United States should be classified. Marginal land now being farmed which is unsuited for economic crop production should be acquired by the government and used for the production of trees for lumber or converted into grazing land.

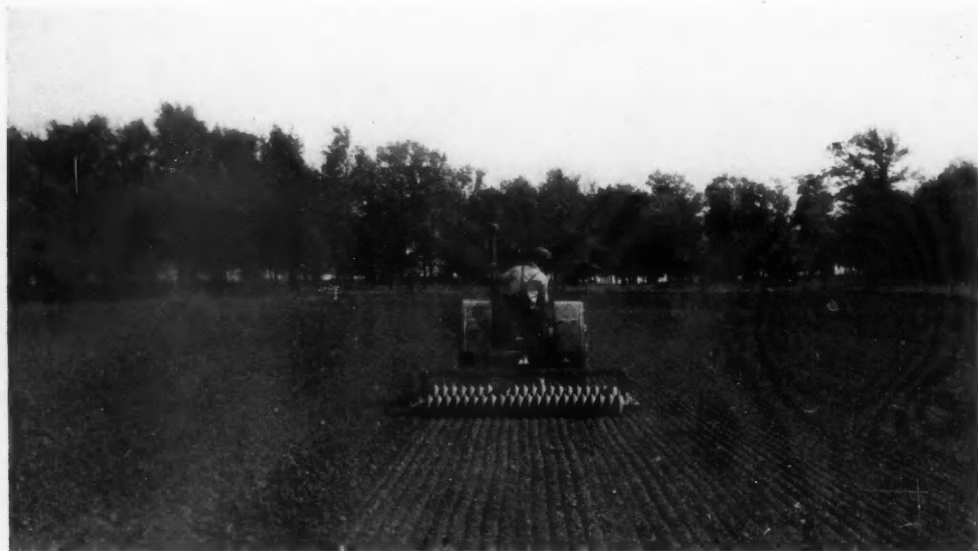


FIGURE 2.—A well-prepared seed bed in Nebraska. (Courtesy of International Harvester Company.)

broader one than the question of the establishment of new reclamation projects by the government. The development of the West is vitally concerned with the establishment of sound irrigation projects on good land established with monies received from the sale or rental of western public lands. The addition of the products of these few thousand acres of new land to the so-called surplus production will have little influence on the general agricultural situation, but is vitally concerned with the developing of the great West.

TAXATION

Since land now has a definite value and crops are no longer produced on free land, the question of taxation has become a vital one in agriculture. In some sections of the country it is really the most vital one.

In an organized state of society taxes are necessary to maintain its functions. The tax burden, however, should be adjusted so that agriculture does not carry more than its just proportion.

In Illinois, Indiana, and Iowa in 1913, the farmer's business receipts



FIGURE 3.—A field of growing wheat in Alberta, Canada. (Courtesy of University of Alberta.)

less all expense except taxes were \$1,147; taxes took \$112, or 9.8 per cent of this. In 1918 taxes took 6.7 per cent of the farmer's income in this region.

In 1921 the prices of farm commodities took a precipitous flight downward, but taxes went up. The net income of the farmer came down to \$771, of which taxes took \$253, or 33 per cent.

In 1921 in Chemango County, New York, the farmer's income was \$795, of which taxes took \$161, or 20 per cent. This left \$634 for the farmer to compensate him for his labor, management, and interest return on an investment of \$12,943.

In certain areas of Washington and Oregon farm taxes amounted to 25 per cent of the total net receipts.

In Monroe County, Indiana, in 1922, taxes took as an average of the three years, 1921–1923, 59.6 per cent of the farmer's net income.

The state land board in Utah announced in November, 1926, that they had 200 farms for sale. The farms varied in value from \$1,000 to \$60,000. They had been acquired by the land board because the owners

could not meet interest charges and taxes on their property.

In Missouri farmers everywhere are suffering from excessive taxation. Hundreds of Missouri farms have been sold for taxes. Taxes on farm land frequently amount to \$5 per acre, yet the actual rental value is only \$7 per acre. Farms have been confiscated to build roads for public use and school houses.

Farm taxes are everywhere delinquent. Sales of farm property are not made because the counties would have to buy. In Kansas there has been a sevenfold increase in tax delinquencies since 1917. Any concerted effort to collect taxes on farm property in certain areas would probably create a panic.

Industrial Conference Board, a manufacturer's organization, presents the following significant data showing that the farming industry is carrying more than its share of this burden.

| | PER CENT OF INCOME PAID IN TAXES | | |
|-------------------------|----------------------------------|------|------|
| | 1913 | 1919 | 1922 |
| Paid by farmers..... | 10 | 8 | 14 |
| Paid by all others..... | 6 | 13 | 11 |

The reduction of income taxes since 1922, which affects few farmers,



FIGURE 4.—Harvesting wheat on a large wheat farm in Alberta, Canada. (Courtesy of University of Alberta.)

and the increase in city incomes probably brings the proportion now about to the 1913 relationship when the farmer paid 10 per cent of his income as taxes while the rest of those in gainful occupations paid only 6 per cent.

Politicians, who are loudest in their cry for farm relief from Congress, are the ones who frequently have placed these excessive tax burdens on the farmer.

Excessive taxation of farm property is frequently due to the tendency to build public roads and support public schools at the expense of local farm districts. In Indiana farmers in certain districts paid 66 cents out of every dollar collected as taxes for road construction and the support of public schools.

Public roads and public schools have outgrown local surroundings. The public road is a national and state problem made so by the automobile and should be constructed and

maintained by national and state support.

School standards for the local rural districts have been created by state law. The support of the rural school is therefore a state problem and not a local one. The burden of maintaining such high standards should be borne in part at least by the wealthy city districts. Adjustments of this sort will assist materially in distributing the tax burden more equally and relieve the farmer of his excessive tax burden.

INFLUENCE OF THE TARIFF

In 1791, Alexander Hamilton while Secretary of the Treasury, recommended to Congress that a tariff be placed on imported manufactured goods as a means of raising revenue and to give our important industries an opportunity to develop. At the same time he called attention to the fact that such a tariff would operate to the disadvantage of the

farmer who produced commodities for export, and he recommended that an export bounty be offered on export agricultural products to offset the detrimental influence of the tariff. The tariff recommendation was adopted, and ever since has been a vital policy of the government, but the export bounty idea on agricultural exports was ignored.

The tariff has had a profound influence on the agricultural situation. It forces the farmer to buy his needs in a market protected by the tariff and to sell his produce in a market

wheat on the Chicago market differs only slightly from that on the Winnipeg market because the price of wheat is fixed by world conditions on the Liverpool market. The problem is not one of disposal only: the farmer has always been able to sell his wheat at *some* price, but the real problem is how can the farmer sell his wheat at an American price, and the tariff does not protect him from world influences.

Similar conditions affect the price of all our major farm commodities which are produced in quantities



FIGURE 5.—The new process of making alfalfa hay on Walker-Gordon Dairy Farms, New Jersey. (Courtesy of Mason Products Company, Philadelphia.)

where the price is fixed by world conditions. Belated attempts to give the farmer protection by putting a tariff on farm products have not been successful. A tariff on a farm product, like olives, of which we do not produce enough for our own consumption is highly effective in getting an American price for an American product. When, however, we produce a farm product in quantities greater than we consume and must export the surplus, the tariff is not effective. A tariff of 42 cents on wheat does keep out a whole lot of Canadian wheat, but the price of

greater than we consume such as cotton, rice, wheat, corn, beef, and hogs. The problem, then, is how can the benefits of the tariff be brought to agriculture so that the farmer can secure an American price for the product of his labor? Is there any better way than that originally suggested by Alexander Hamilton of putting an export bounty on farm products? Many farm leaders believe this should be adopted as a fundamental government policy.

TRANSPORTATION

Transportation is vitally neces-

sary for efficient agriculture. The construction of highways is of the utmost importance for the effective movement of farm crops. But the farmer is not the only one who uses the highways. The construction and maintenance of highways is a problem of the whole people. The highways should be built and maintained by those who use them. There is no

of a uniform national agricultural policy for the immediate future. The great growth of industry in the East has resulted in the concentration of the consuming public in large cities, but wheat is still produced out on the prairies, and the price the Dakota farmer gets for his wheat is the price the automobile mechanic in Detroit pays for his flour less the cost of as-



FIGURE 6.—A standardized farm product—oranges graded and packed for the market in a California packing house operated by the California Fruit Exchange. (Courtesy of California Fruit Exchange.)

more equitable way of doing this than by maintenance of a national and state policy of highway construction supported by a national tax on the sale of new automobiles and the state tax on the sale of gasoline. There should be no tax on farm land for road construction.

The attempts to secure equitable freight rates for agricultural products should constitute an important part

sembling, processing, transportation, and distribution. The high transportation charges on farm products, due to high wages of railroad employees, materially cut down the price the Dakota farmer receives for his product. Any method which will reduce the cost of transportation of farm products to the market will vitally influence the farm situation.

NEED FOR A SALES ORGANIZATION

The method of the distribution of farm products also often works to the disadvantage of the farmer. Agencies for the distribution of food products are well organized, fully financed and efficiently managed. The *individual* farmer, owing to the small scale of his operation, lacks adequate financial backing and proper market information, and is, therefore, often unable to bargain successfully with these agencies for the sale of his product. The farmer, therefore, has a distorted view of the middlemen whom he regards as a gigantic monster riding roughshod alike on the shoulders of the producer and consumer. This point of view is really the basis of the cry for the elimination of the middlemen which has been so prevalent in farming circles during the past few years.

The only solution of the difficulty of distribution of farm products is through organized effort. The organized group of farmers can secure capital, information, and efficient management which will permit the group to deal successfully with marketing agencies the sale of farm commodities. The successful coöperative marketing association will use all of the present marketing agencies, but in a more efficient way.

Such organizations must organize locally on the basis of commodities but, to be effective, must be federated into state and national groups. Such organized groups will be in a position to secure efficient management and finances not only for their own needs but also for their individual members.

Such organizations must be managed as a business organization is managed. It cannot be run on the principle of a town meeting by the in-

dividual farmers. Responsible management must be in charge. The farmer must never forget that his problem is primarily one of individual production.

Every encouragement should be given agriculture in the formation of coöperative associations for this purpose, both in sympathetic appreciation, by the public as a whole, of the problems confronting the farmer, and the development of the coöperation by the government itself. Coöperative effort on the part of farmers is simply an attempt to secure some of the benefits for agriculture that industry has been able to secure by corporative effort during the past fifty years.

The only alternative for agriculture is the complete scrapping of the present system of food production on small, one-man sized farms and the development of a corporative form of agriculture similar to that developed in other lines of industry in the United States since the Civil War.

Six million and a half farmers cannot continue to do business successfully, each as an individual, in competition in a highly organized state of society where other interests deal in groups.

FARM EFFICIENCY

Those who are not conversant with the farm situation are prone to think the reason that there is a farm problem is that while the industrial world has been making great strides in efficient production the farmer has been content to continue the use of methods used by his grandfather. The American farmer makes abundant use of tractors, threshers, separators, gasoline motors, pumps, and cultivators. There has been greater development in the use of farm machin-

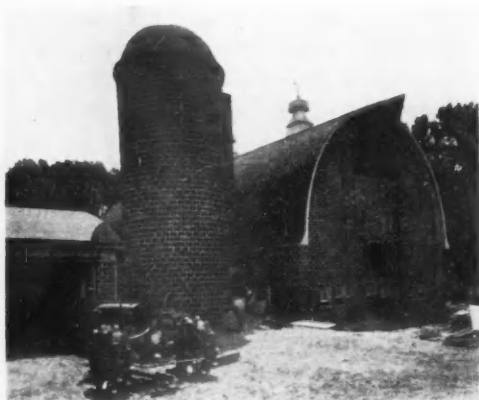


FIGURE 7.—A modern dairy barn and silo on an Illinois dairy farm. (Courtesy of International Harvester Company.)

ery on the farms of America during the past fifty years than during all previous history. The amount of human labor required to produce crops has been materially reduced and as a result fewer farmers are now required to produce the food the consuming public needs.

In 1820, 85 per cent of those gainfully employed were engaged in agricultural pursuits. In 1920, however, only 26 per cent of those gainfully employed were engaged in agriculture. During the hundred-year period the proportion of those engaged in agriculture has markedly decreased. There has been a steady migration of workers from the agricultural field into other lines. This has taken place both during prosperous times and periods of agricultural depression. In 1910, there were 12,659,203 persons gainfully employed in agriculture, while in 1920 there were only 10,953,158 persons so employed. During the most prosperous period in agricultural history 1,602,045 persons left farming for other pursuits. This tendency still continues as indicated by the fact that the farm population decreased

by 649,000 persons in 1926 alone. This tendency is a healthy one as there are still too many farmers on the farms of America.

THE SIZE OF THE FARM BUSINESS

Farming as now carried on in the United States is being done on 6,300,000 units of various sizes, most of them very small. In this period of business mergers and industrial combinations, farming is still largely a one-man affair. The idea that farming of necessity in this country is based on the foundation of a small land-owning operator and centralization is not only impractical and undesirable is deeply rooted. Is it necessarily true that the future welfare of the country is based on our maintaining the small farm unit? In the early days of our life as a nation this was probably true, but now that the farm is no longer a self-sufficing unit it is open to question. Farming is now a commercialized industry subject to the same economic laws that affect other lines of industry but less able to adjust itself to changes in economic conditions because of the very nature of its business. The small farm unit may be a very desirable place on which to live, but such a farmer is not economically employed. It is inevitable that small farm units in many cases be consolidated into larger units if a business success is expected. This must take place or else the farmer must change his type of farming to a more intensive form. Of course, the small farmer may continue to exist on such a farm if he chooses, but there is no reason why he should expect to make a success of it as a business proposition or to have such success guaranteed him by the government.

THE NATION'S INTEREST IN AGRICULTURE

One-third of the entire population of the United States lives upon the farm and is directly dependent upon the income therefrom for their livelihood. The farming communities offer the best market for many of the products of industry. Unless farming is prosperous there can be no *permanent* prosperity in America for labor and industry.

The farm problem is one that concerns the whole people even more than it does the farmer himself. The young man who finds farm life unsatisfactory or unprofitable will not undertake such an occupation. The steady drift of population from the country to the city and the decrease in student enrollment in agricultural colleges are very significant in this respect.

The prosperity of the urban centers has been based in a large measure on cheap food produced on cheap government land. The era of cheap food is now rapidly passing and the city dweller will soon be faced with a problem of an adequate food supply.

When a worker in the agricultural field receives approximately one-third the compensation of his labor and effort as does a worker in other lines of industry, there must be something radically wrong somewhere. There is no one single thing responsible for this condition. The farmer himself can make and is making adjustments which will help his condition; but it is folly to tell the farmer that he must help himself when as in some cases the farmer is paying 68 per cent of his net income in taxes! The tax burden must be equally adjusted and universally applied without any exemptions. The anti-

quoted and unscientific system of collecting 90 per cent of county and state taxes in real property must be abandoned for a more just system.

It is not enough to tell the farmer that the economic law of supply and demand cannot be amended by Congress and that the law of the survival of the fittest must prevail.

The farmer knows that the restrictive immigration law was secured by organized labor in order to protect itself from competition. No one doubts for a moment that this law interferes with the economic law of supply and demand for labor. The passage of this law helps labor maintain working conditions and secures wages which could not be obtained in any other possible way.

The tariff interferes with the law of supply and demand and enables the manufacturer to secure an average price far above that of the same article elsewhere.

Freight rates are adjusted by the Interstate Commerce Commission in accordance with the Transportation Act which holds up $5\frac{3}{4}$ per cent as the minimum return which should be obtained. All public utilities have been placed on a sound basis by law which adjusts the price for their services.

The establishment of the Federal Reserve System by law has stabilized the banking industry of the nation.

The farmer knows all these things and wonders why his own industry cannot also secure some of the prevailing prosperity so abundantly enjoyed by labor and industry by law enforcement. This is now finding expression in the insistent demand for farm relief.

Agriculture is the largest single industry in the United States. Farmers are not securing their share of

the national income. Whatever may be the reason or reasons for this condition, there cannot be any permanent prosperity in this country while so large a portion of the population is in distress.

The situation is fraught with se-

rious political consequences. This country cannot afford to indulge in class warfare. The agricultural situation merits the sympathetic and earnest consideration of all thoughtful people in order that a sane solution may be obtained.

FOREST REGENERATION IN PORTO RICO

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PORTO RICO occupies the most eastern and northern position of the group of islands collectively known as the Greater Antilles. It does not enjoy a forested condition and as a part of the Caribbean region this island, with an area of 3,435 square miles, is an outstanding exception in this respect.

There is little doubt that Porto Rico was at one time densely forested. Mr. Alex Wetmore, who completed a study of bird life of the island in 1916, states that "On examining the endemic species of Porto Rican birds, I find that with one or two exceptions they are forest inhabiting forms, pointing thus to a very extensive forested area on the island."

Against the present fragmentary state and limited extent of Porto Rico's forest growth we find that historical evidence indicates a once completely forested island. Comparing Porto Rico with other islands of the Caribbean group whose land surfaces are now covered with forests, from all appearances virgin in character, further indication is found as to the probable previous well-forested condition of Porto Rico. Chanca, the fleet physician for Columbus on his memorable voyage in 1493, states in a report to the Municipality Corporation of Seville describing the expedition's experiences that "In this island it is wonderful to see the dense forest and the great variety of unknown trees, some in bloom, others in fruit and everything looking so green."

Oviedo, writing of the year 1500 concerning animals, trees, and the like in Porto Rico, states that they did not differ from those already described in the "Isla Espanola." In the account of the capture of San Juan, Porto Rico, by the Earl of Cumberland in 1597, the small island on which the city of San Juan is located is described as "for the most woods." Continuing, the Luquillo region and the interior in general is described as follows: "The valleys are much wooded, but in many places interlaced with goodly playnes and spacious lawnes. The woods are not only underlings but timber trees of goodly tallnesse and stature, fit for the building of ships and every part of them." Herrera states (English translation of 1726): "The island . . . has much good pasture for cattle, which decreases by reason of the great number of trees increasing . . . so that the island is overgrown with woods." According to the *North American and West Indian Gazetteer*, issues of 1778, "The sides of the hills are covered with trees of various kinds, proper for building ships and other useful purposes." Fray Inigo in 1788 mentions the superior and greater variety of timber trees in the uplands and indicates that many trees existed in the southern part of the island where conditions were more arid and less fertile than on the north coast. Another historian, Flintner, in 1843, referring to the locality of Guayama describes the site of the town as "previously an

immense tract of woodland," quoting further, "The forests which cover the mountains of Porto Rico are filled with timber of the best quality for the construction of ships and houses. In some parts of the coast from the very improvident manner in which the wood has been cut down and burned for charcoal and much left to rot on the ground, the timber is getting scarce; but in the interior there is yet an abundance of superior timber."

Final clearings, severe burning,

economic value. The total area of Porto Rico equals approximately 2,200,000 acres. Of this amount, according to the Department of Agriculture of Porto Rico figures for 1924, 550,000 acres or 25 per cent of the total area is cultivated land; another 550,000 acres is pasture land and the remaining 50 per cent of the total land area (1,100,000 acres) is relatively better suited to the production of forest crops.

Porto Rico's forestry problem concerns the regeneration of its once



FIGURE 1.—The Atalaya Mountains in the western portion of Porto Rico showing their barrenness.

and the previous cutting of the more desirable timber trees, all in preparation for the planting of coffee, tobacco, cane, or other crops, continuing over a period of time, has resulted in the present naked state of the Porto Rican hills and valleys. The latter and other topographically suited and fertile areas have been justly devoted to agriculture or coffee growing; but there remains today approximately 1,100,000 acres of forest, brush, swamp, and barren lands of which but an insignificant part contains forest growth of any eco-

nomical value. This involves the restoration of the 1,100,000 acres of forest land to a place of profitable, rather than the present state of profitless, activity.

Geologic history indicates that the West Indian Islands, Central America, and northern South America, or the entire Caribbean region were at one time a united Continental land mass. Brownson Deep, lying immediately north of Porto Rico in the Atlantic with a depth of 24,000 feet,

and Tanners Deep in the Caribbean to the South, reaching 15,000 feet in depth, offers the consideration that Porto Rico, together with the other West Indian islands, at one time formed a mountain chain with a general east and west trend, which remained above water in a connected land mass following one of the upward earth movements. The last subsidence accomplished the breaking up of this chain into the present island groups. But, the barest outline of the geologic history, however,

ing, and clearing, succeeded by the planting of some small food crop, continuously cultivated until the surface soil is either worn out or washed away (usually accomplished in three or four seasons), followed by complete abandonment is the cause of the present barren and exposed state of the thousands of acres. A country as small in size as Porto Rico, with a population of 325.5 persons per square mile and 79.9 per cent rural, can little afford to permit such a condition as this to exist.



FIGURE 2.—Forest land, once the site of valuable hardwoods, now a public and private liability.

of Porto Rico is known, and it remains for subsequent studies of this little-known region to account for the various geologic occurrences.

The cycle of abundant forest resources destroyed by human activity and disregard, followed by a period of regret and attempts at replacement, is complete in Porto Rico. The "conuco" system of farming, a shifting method of agriculture employed by nomadic people, is responsible for Porto Rico's deplorable condition. Years of cutting, burn-

Abandoned and run-down lands on low, flat surfaces may recuperate naturally in the course of time, if left to themselves, aided by the accumulation of top soil washed down from higher slopes, and when the financial value of the intended planting permits, a soil crop may hasten reclamation of the area; but abandoned land on exposed slopes whose degree of declivity is such that all top soil, which contains by far the most important element amounts necessary for plant nourishment, are not easily

rejuvenated even by artificial means when such are justifiable. Furthermore, seldom are such lands desirable from the standpoint of intensive cultivation and hence their recuperation is left to the possibilities of their abandoned condition. Slopes exposed to the heat of a tropical sun and the other elements of tropical climate receive little natural aid for the reestablishment of soil fertility. The rains and winds in addition to the sun beat unmercifully upon their barren surfaces, tearing down and

which the island is in great need, but because of the protective cover such a canopy supplies to the soil and the plant food nutrients it makes available in the form of leaves, twigs, and other vegetative matter. A forest crop which protects the soil from baking in the heat of a torrid sun; prevents the beating and washing away of the surface soil during torrential tropical showers; aids the retention of moisture on inclined areas and the decomposition of vegetative matter; which supplies much-



FIGURE 3.—Sugar cane, the primary agricultural crop of Puerto Rico, being grown in the valley; the devastated hills in the background produce nothing. Vicinity of Yauco.

eroding them beyond apparent repair. The detrimental effect of such a process, the result of years of weathering, cannot be counteracted in a short period of time. Occurrences of such magnitude must be controlled by factors equally as great and effective in ability to offset further damage as well as to repair that already done.

The practice of forestry concerns the reestablishment of suitable forests on these areas, not alone from the standpoint of wood production of

needed wood and which increases soil fertility and brings into use thousands of acres of land now an absolute loss to both individual and country, is the salvation from absolute ruin of nearly 50 per cent of Porto Rico's land area.

In tropical regions where it is generally supposed that vegetative growth abounds on every hand and where tree growth is considered as being rapid, it would seem that the reestablishment of forests on such areas could be quite readily attained. This would be true were the factors

of soil equally as favorable for tree growth as the factors of climate. But the soil on the hill and mountain slopes which comprises practically the entire amount of forest land in Porto Rico has, under the influence of constant warm weather and abundant rainfall, been leached out of the original nutrient constituents and the humus content excessively decomposed or completely washed away. Furthermore, the forest land occurs coincident with the "old land series" of geologic formation, which is of volcanic origin, and it is highly questionable if such soils on sloping areas, exposed to tropical conditions of climate, retain for any length of time the composition of the original basaltic lava. Rocks and soils from this source decompose with tremendous rapidity in tropical regions and, as a result, the so-called clay soils of Porto Rico are only mechanical in analysis, not in composition. They are very low in silicates and high in their content of iron and aluminium hydrates, and are referred to as laterite soils. These red clay-like soils, extremely heavy and that pack and puddle badly even to the extent of being impervious to air and water, which are formed from lava, decomposed through the action of periods of drought and tropical downpours, are those upon which Porto Rico must depend for the reestablishment of her forests. Other soils better suited for vegetative or forest growth are employed for higher and more popular use. We have, then, pitted against the favorable conditions of climate, permitting almost a continual growing season, the unfavorable conditions of soil which renders forest regeneration from a practical standpoint, a difficult procedure.

In the establishment of forest



FIGURE 4.—The "mango" tree (*Mangifera indica* L.) of the *Anacardiaceae* in a condition of "high coppice." The branches as produced by sprouting are cut for firewood. The soil beneath, agricultural in character, being relieved of overhead shade, is put in sugar cane.

stands in the temperate zone of the United States, once the tree seedlings take hold, under normal conditions of soil, climate, and treatment, they will survive and crowd out the competitive grasses and lesser herbaceous vegetation. Furthermore, soils that are considered unfit for desirable forest growth are not deemed worthy of the necessary financial investment to establish forest plantations; and such "sites" are not recommended for forestry use.

The establishment of forest plantations in Porto Rico, however, in addition to abnormal conditions of soil, has to contend with what is

termed "maleza" which constitutes all grasses, weeds, woody shrubs, and vines. This "maleza" grows so rapidly and reproduces so prolifically under all local conditions of soil and climate that it requires continual attention to keep it from crowding out and quickly killing young tree seedlings. It is costly to free a plantation from "maleza" and, since it readily returns to its former state of existence even when apparently completely destroyed, the expenses of "maleza" destruction, necessary to preserve a forest plantation, almost immediately amounts to an expenditure prohibitive of profit from the enterprise. Thus, private owners of forest lands do not find the growing of timber to be attractive, for while the ultimate financial returns of a wood crop as computed on the basis of present market prices are interesting, from a business standpoint the margin of safety between the success and failure of maturing a forest plantation, with the limited knowledge and experience concerning their establishment and treatment at hand, is insufficient to assure reasonable protection of capital invested in such a venture. Supplementing this unattractive feature, experience of the past five years in forest plantation establishment in Porto Rico, indicates that the initial investment for area preparation and "maleza" destruction involves an expense of such magnitude that it makes the private owner and operator reluctant to initiate the work.

There have been no accurate and detailed classification of the total land area of Porto Rico, although various and somewhat diverse estimates have from time to time been made. The following generalized statements embody a classification

of the land area based on statistics issued by the Department of Finance of Porto Rico for the year 1910:

| <i>Land Area</i> | <i>Acres</i> | <i>Per Cent</i> |
|--|--------------|-----------------|
| In actual cultivation | 550,000 | or 25 |
| In pasture or grass land | 550,000 | or 25 |
| Of forest, brush or waste land | 1,100,000 | or 50 |
| Total (approximately) | 2,200,000 | 100 |

Only a small part of the 1,100,000 acres of forest, brush, and waste land contains any forest growth of material value. This amount is so small that for all practical purposes it is negligible. Additional statistics from the Department of Finance show that the amount of privately owned lands in Porto Rico totals 2,073,847 acres, allowing but 126,153 acres or 5.7 per cent of the total land area in public ownership. The Insular Forests created by governmental proclamation include 15,000 cuerdas,¹ more or less, of mangrove swamp land (Act of May 28, 1918); and 25,000 cuerdas, more or less, of uplands (Act of December 22, 1919). In 1903, by presidential proclamation of the United States the Luquillo National Forest was created in Porto Rico. This originally contained about 12,000 cuerdas of mountain land, but since its establishment some 3,000 cuerdas of adjoining lands belonging to the Insular government of Porto Rico were transferred to Federal jurisdiction of the United States and included as a part of the Luquillo National Forest, making the total land area embraced within this forest land unit as being 15,000 cuerdas.

Considering the foregoing, it is found that the total amount of forest land under public ownership or control in Porto Rico is 55,000 cuerdas,

¹ Cuerda is the Spanish term for acre. In Porto Rico 1 acre equals 1.029 cuerdas. 1 cuerda equals 42,306 sq. ft.



FIGURE 5.—*Cedro espinosa* of Panama and *Cedro macho* of Nicaragua—*Bomba copsis* sp. of the family Bombacaceae.

or but 2.5 per cent of the total land area of Porto Rico. This represents, for the most part, forest land only, which contains, from an economic standpoint, very little if anything in the way of timber trees of value. The 40,000 cuerdas of forest land designated as Insular Forests² are distributed as follows: The insular mangrove swamps (15,000 cuerdas) which at their maximum produce wood, restricted in use for the most part to firewood and charcoal, are scattered along the coast in the littoral belt in some twenty different municipalities. At the present time most of them do not contain material sufficiently large for cutting and it will be some time yet (probably ten or more years) before they will sup-

ply any significant quantity of wood for fuel purposes. The upland insular forest units are comprised in four areas as follows: the Maricao forest area which contains something over 5,000 cuerdas of moist mountain land and which is situated near the town of Maricao in the western end of the island. About 3,000 cuerdas of this area is covered with a woody vegetative growth composed of inferior species of very little economic value, and the remaining 2,000 cuerdas is barren and denuded land; the Guanica Harbor and Point Barraca forest areas contain together about 6,000 cuerdas and are located on very dry and exceedingly rocky land on the south side of the coast hills east of Guanica Harbor. Much of the land within these areas is too rocky for any use. Cattle may be grazed on portions of the areas, but the grass growth is so scanty that this use even is scarcely justifiable. The woody growth contained within the confines of these areas has long since been removed or destroyed, so that they support no forest growth of value at the present time. The Mona Island forest area, located on Mona Island about 100 miles off the west coast of the island of Porto Rico, contains about 14,000 cuerdas, 13,000 of which are too dry and rocky to support tree growth, and the remaining 1,000 cuerdas, although containing fertile soil, because of the distant location of the island, is impractical for immediate forest development. Eliminating the 15,000 cuerdas of mangrove land, the 13,000 cuerdas of land mentioned on the Mona Island unit and the 6,000 cuerdas of land in the Guanica Harbor and Point Barraca units, for the reason that for all practical forestry purposes their value is highly uncer-

² Forest land is defined as land relatively more suited to the production of a forestal rather than an agricultural crop.

tain, we find that of the 55,000 cuerdas of public land considered as forest land units in Porto Rico but 21,000 cuerdas have any practical possibilities of forest production. Thus, the public forest land area capable of producing a forest crop of economic value is reduced from 2.5 per cent of the total land area of Porto to less than one per cent of the total area.

The result from a forestry standpoint is obvious. The island government must purchase areas suitable for the practice of forestry and in sufficient quantities that its domestic needs can be supplied by the wood materials produced thereon, or the equivalent must be accomplished by the private owners of such land under whose control at present 94.3 per cent of the total land area of the island lies. Considering that the government of Porto Rico undertook to purchase the necessary areas for the establishment of forest plantations, 639,000 cuerdas would be needed to supplement the 21,000 cuerdas now owned to make up the desirable 660,000, or 30 per cent of the total land area, which amount it is generally considered a country requires. At \$2.00 per cuerda, the possible average figure for which such land could be purchased, the expense incurred for the purchase of suitable forest lands calculates \$1,278,000. In addition to this the cost of seedling production, planting, area preparation, maleza destruction, treatment, management, and the interest charge against the investment must be added which increases the total expense to considerable more than the initial amount expended for land purchase.

The private land owner as previously stated, owns 94.3 per cent. He



FIGURE 6.—The "Quipo" tree of Panama (*Cavanillesia platanifolia* of the family *Bombacaceae*).

recognizes that idle land is a liability, and is ready to convert such land into a state of activity wherein it will return a profit; or he would possibly be satisfied if such land would carry its own expenses, of care, interest, and taxes. The question arises: Will the private owner jeopardize investments of capital, in addition to the amounts involved in the land values, in order to establish forest plantations without reasonable assurance that they will grow and progress to a profitable maturity? It is unfortunate that forestry agencies, in Porto Rico, are not equipped to intelligently advise such owners as to what they may best do and expect. The condition is more unfortunate and serious when it is considered that Porto Rico needs must look to these private

owners for the "lion's share" if the island is to produce adequate domestic supplies of wood products.

The cart is before the horse in so far as Porto Rico's forestry practice is concerned. The necessity for forestry is preached when that same necessity is generally well recognized. The situation requires less publicity and more intelligent practical and technical advice concerning its actual establishment; it needs less propaganda and more earnest and honest work in order that the already long-standing deforested condition may be remedied; fewer politics and a specific effort to place forestry on a practical basis. While the situation is tragic and the problem intricate and complex, it can be solved if the solution is sought. Conditions surrounding forestal activity in Porto Rico demand intensive investigation and research with a view looking toward intelligent and economical plantation establishment with the hazard of premature death reduced to a minimum; facts concerning which will enable the private owner of forest land and likewise the government to secure a wood crop of sufficient value to justify the practice.

Such are the conditions—natural, economical, and political—which affect the practice of forestry in Porto Rico. Technically the work involves artificial regeneration in its entity, as desirable trees from the standpoint of seed or species are either nonexistent, scarce, or are located in unsuited areas. Furthermore, on such soils as have been previously described, the proper seed-bed conditions for germination are wanting. Hence, planting stock must be used. Domestic sources of suitable indigenous seed are far from being abundant, but it is doubtful if the present

practice of importing tree seed of expensive exotic species for reforestation purposes is to be recommended.

The presumption concerning a deforested country such as Porto Rico would be that areas containing forest stands composed of desirable tree species would be few, if any at all, and far between. This is the actual case. In fact, such areas, of even small dimension, are so scarce that it is difficult to find a satisfactory expression of the possibilities of tree growth in forest stands on the island. One or two protected areas of virgin growth natural forest exist. The Sardinera Forest, almost at sea level elevation in the vicinity of San Juan, contains a number of large trees and an undergrowth of various species. Another much smaller patch of natural forest, also privately owned, is located near Pueblo Viejo at an elevation of about 300 feet. Here, several single specimens of important forest trees now restricted to the higher mountains are being protected. These are Tabanuco (*Dacryodes excelsa*), Granadilla (*Buchenaria capitata*), Maricao (*Byrsonima spicata*), and Ausubo (*Mimusops nitida*).

Of chief interest and value to forestry in Porto Rico, however, is second-growth data, for it is on this class of forest growth that the island is dependent for her future forests. Second-growth forests of known age and that contain desirable tree species are even scarcer on the island than protected areas of virgin growth natural forests.

Some 300 or more meters north of the main "carretera" highway from Aguadilla to Isabella, in the northwestern part of the island, in a "barrio" district of Aguadilla known as "Camaselles," is located the "finca" farm "Las Palomas," owned

by Victor Castaner. On this farm of 28 cuerdas there is an area 0.88 acres in extent by actual survey which supports an efficient stand of second-growth mahogany (*Caoba* or *Swietenia mahogani*). A study was made of this tract by the writer



FIGURE 7.—*Cedrela mexicana* of the *Meliaceae*. In the valley of the Usamacinta River between Peten, Guatemala, and Tobasco, Mexico.

(February, 1925) in order that a record might be had of the reproductive possibilities on such areas by a valuable tree species and in order that an expression might be available of the growth of mahogany as reforestation crop. The owner claims the stand, probably the largest and oldest trees contained therein, to be from 25 to 30 years of age. The

soil is a clay loam, alluvial in character upon a calcareous formation. Geologically it occurs in the region of the "younger or tertiary series" coincident with the location of the coastal plain region. The examination of the stand shows a total of 447 trees on the area, 432 of which are mahogany (*Swietenia mahogani*) and 15 of which are of 7 distinct species, as follows; 9 Nisperos (*Achras zapota* L.); 1 Genipe (*Melicocca bijuga* L.); 1 Javillo (*Hura crepitans* L.); Higuero (*Crescentia cujete*); Ceiba (*Ceiba pentandra* L.); Malagueta (*Amomis caryophyllata* Jacq.) and 1 Tamarindo (*Tamarindus indica* L.). Thirty-one per cent of the mahogany trees, or 139 in number, are merchantable, a total figure of 570 cubic feet of mahogany on the tract. Using the diameter of the average merchantable tree as 8.3 inches for the basis of calculation and applying the conversion factor of 5.7 board feet per cubic foot, 3,249 board feet of merchantable mahogany is figured as being on the tract of 0.88 acres. This amount equals 3,578 board feet per acre. Mahogany is quoted in Porto Rico, on an average of \$120 a M board feet of cut boards about one inch thick. Allowing the cost of \$50 for logging and milling, we arrive at the figure of \$250.46, which roughly approximates the financial return of the merchantable mahogany of this tract on a per acre basis. Considering that it required from 25 to 30 years of growth to produce this amount, ignoring interest charges, etc., the approximate amount of \$8.34 per acre per year represents the apparent gross return. This is on a soil which is agricultural and not forestal in character, and hence a type of soil that has greater potential possibilities than the vast amount of

forest land in Porto Rico. The growth, on the other hand, could have been increased by intelligent care and management, but the results serve to illustrate that the establishment and care of plantations in Porto Rico has many unfavorable factors to contend with and that the private operator will not find the growing of trees to be a treasure ship. Second-growth forest stands of known age are of infrequent occurrence in Porto Rico and, as no pertinent information has been published previously, the following data is of importance and value:

According to the records kept by Mr. T. B. McClellan of the station staff, at two years of age in April, 1915, the tree heights measured to the nearest foot were as follows:

| No. of Trees | Height (Feet) | No. of Trees | Height (Feet) |
|--------------|---------------|--------------|---------------|
| 4 | 2 | 5 | 9 |
| 3 | 3 | 6 | 10 |
| 2 | 4 | 6 | 11 |
| 8 | 5 | 3 | 12 |
| 5 | 6 | 3 | 13 |
| 7 | 7 | 1 | 14 |
| 4 | 8 | 1 | 18 |

The 58 trees included in the measurements were healthy specimens and had an average height of about $7\frac{3}{4}$ feet.

TABLE 1
BARRIO "CAMASELLES" OF AGUADILLA, PORTO RICO
(Tract area equals 0.88 acres)

Owner—Victor Castaner. Age—25 to 30 years, February, 1925. Soil—Agricultural, clay, loam

| | Caoba, Mahogany (<i>Swietenia</i> mahagoni Jacq. Meliaceae) | Sapodilla, Nispero, (<i>Achras</i> zapota L. Sapotaceae) | Genipe, Geniptree (<i>Melicocca</i> bijuga L. Sapindaceae) | Javillo, Sand-box tree (<i>Hura</i> crepitans L. Euphor- biaceae) | Higuero, Calabash tree (<i>Crescentia</i> cujete L. Bignonia- ceae) | Ceiba, Silk-cotton tree (<i>Ceiba</i> pentandra L. Bomba- caceae) | Malagueta, Bayrum tree (<i>Amomis</i> caryophyl- lata Jacq. Myrtaceae) | Tama- rindo, Tamarind tree (<i>Tama- rindus</i> indica L. Legumi- nosae) |
|--------------------------------|---|---|---|---|---|---|--|---|
| No. of trees per tract | 432 | 9 | 1 | 1 | 1 | 1 | 1 | 1 |
| No. of trees per acre | 552 | 10 | 1 | 1 | 1 | 1 | 1 | 1 |
| Diameter of average tree | 5.8 | 6.2 | 11.7 | 15.4 | 5.9 | 13.3 | 12.0 | 4.0 |
| Height of average tree (Total) | 65.1 | 62.9 | 85.7 | 90.0 | 73.5 | 87.3 | 80.0 | 50.0 |

The United States Federal Agricultural Experiment Station at Mayaguez, Porto Rico, has, for a number of years past, planted out from time to time various tree seedlings, mostly as single specimens on agricultural soils. While the records concerning these plantings are not complete, the age of the specimen trees, their present location, origination, and identity is known.

The following data concerns Venezuelan mahogany (*Swietenia candollei*, *Pittier*), which were grown from seed obtained in Caracas, Venezuela. The seed was planted at the station in Mayaguez, Porto Rico, in May, 1913; following the germination, the seedlings were set out on the station property.

The following year, in April, 1916, the trees were again measured in height, 55 trees being sound and healthy with an average height of 16 feet, 40 trees being 14 feet and over in height. The greatest height measured of any one tree was 30 feet. The detail as of this year is as follows:

| No. of Trees | Height (Feet) | No. of Trees | Height (Feet) |
|--------------|---------------|--------------|---------------|
| 1 | 3.5 | 1 | 30.0 |
| 1 | 4.5 | 3 | 22.0 |
| 1 | 6.0 | 4 | 12.0 |
| 1 | 6.5 | 1 | 13.0 |
| 2 | 8.0 | 2 | 14.0 |
| 1 | 9.5 | 6 | 15.0 |
| 1 | 10.0 | 2 | 16.0 |
| 1 | 11.0 | 3 | 17.0 |
| 1 | 11.5 | 8 | 18.0 |
| | | 6 | 19.0 |
| | | 5 | 20.0 |
| | | 4 | 21.0 |



FIGURE 8.—A stand of Central American pine in British Honduras.

In March, 1925, when the trees had arrived within two months of being 12 years of age, the writer personally examined them and found a total of 49 trees, 45 of which were healthy and sound, all growing along a roadside, a row on each side, each tree spaced 15 feet apart, this being the location and manner of the original planting.

Other tree species, seed being collected at diverse times germinated and the seedling set out by and on the grounds of the Federal Agricultural Experiment Station in Mayaguez, Porto Rico, include the Guango tree, *Pithecolobium saman*, and the Acacia, *Albizia stipulata*. The two former specimens were grown from seed collected in Ponce, Porto Rico, in 1908. In March, 1925, when the following measurements were taken by the writer they were 17 years of age:³

³In all examinations made by the author in connection with this article, the measurements concerning D. B. H. (diameter breast high) were taken with tree calipers; total heights were taken with a Hypsometer after Faustmann; diameters at middle tree height were estimated ocularly as were also the length of clear bole.

TABLE 4

| D. B. H. (Inches) | Total Height (Feet) | Middle Diameter (Inches) | Clear Length of Bole (Feet) |
|----------------------|------------------------|--------------------------------|-----------------------------------|
| 19.1 | 45 | 13 | 12 |
| 28.5 | 74 | 20 | 15 |

The following seedlings of the same species were set out in August, 1914, when less than a year old, and were in March, 1925, when measured by the writer, 12 years of age:

TABLE 5

| D. B. H. (Inches) | Total Height (Feet) | Middle Diameter (Inches) | Clear Length of Bole (Feet) |
|----------------------|------------------------|--------------------------------|-----------------------------------|
| 11.8 | 43 | 6 | 9 |
| 7.7 | 26 | 5 | 7 |
| 8.0 | 34 | 5 | 10 |

Ten specimens of the Acacia, *Albizia stipulata*, were planted in March, 1910, on the Experiment Station grounds as seedlings less than a year old. But five of these specimens remained in March, 1925, when the writer took the following data, 15 years of age:

TABLE 6

| D. B. H. (Inches) | Total Height (Feet) | Middle Diameter (Inches) | Clear Length of Bole (Feet) |
|----------------------|------------------------|--------------------------------|-----------------------------------|
| 31.5 | 72 | 20 | 18 |
| 20.1 | 67 | 14 | 14 |
| 17.5 | 51 | 10 | 11 |
| 16.5 | 70 | 11 | 15 |
| 18.8 | 62 | 12 | 16 |

Five Porto Rican mahogany trees, Caoba (*Swietenia mahagoni*), were planted on Arbor Day in 1915 on the grounds of the University of Porto Rico, Mayaguez, Porto Rico, by Prof. H. T. Cowles, and which were in March, 1925, when the following measurements were made by the writer, 10 years of age. The seedlings were about 8 months of age when set out and were grown from seed locally collected.

TABLE 7

| <i>D. B. H.</i> (Inches) | <i>Total Height</i> (Feet) | <i>Clear Length of Bole</i> (Feet) |
|-----------------------------|-------------------------------|---------------------------------------|
| 7.0 | 27 | 5.1 |
| 5.5 | 20 | 3.2 |
| 9.0 | 26 | 4.0 |
| 4.9 | 21 | 3.4 |
| 3.9 | 24 | 3.3 |

ADDENDA

The importance of tropical forests with their varied products and uses each year becomes more firmly established. They offer raw wood materials which cannot effectively substitute in the major uses employing coniferous wood, but while coniferous woods form a large part of the forest resources of the continental United States, they are limited in occurrence in the tropical zone to relatively smaller and restricted areas. Hardwoods in the temperate zone of the United States, on the other hand, occur much less extensively and are even more rapidly diminishing in supply than conifers. The reverse is true in the torrid zones of the Americas; tropical hardwoods occur more extensively and abundantly than do coniferous species. The natural conclusion to such a distribution of forest classes and character of utilization in the face of depletion on one hand and an abundance on the other is to the effect that the

hardwoods of the tropical Americas are available as suitable substitutes for uses to which temperate zone hardwoods of the United States have been previously employed; and that with the increasing scarcity of temperate zone hardwoods and the proximity of the tropical Americas to the commercial markets of the United States, the products of these virgin hardwood stands are finding increasing favor.

Tropical hardwood forests include species adaptable for most uses, if not all, to which temperate zone hardwoods are now employed. Substitution of tropical hardwoods for temperate zone hardwoods has already been tried with success by manufacturing concerns in a number of instances. Lack of information, however, both technical and practical, relative to the precise characteristics of the less known species, handicaps further and more intensive exploitation and utilization.

Tropical conifers (pine) forests of commercial importance are also available for exploitation and utilization although to a lesser and limited extent. These, for the most part, are located in Mexico, British Honduras, Spanish Honduras, Nicaragua, and Santo Domingo. This pine compares favorably to the southern United States yellow pine of trade. As a manufactured product it is already accepted with satisfaction in identical consuming markets. Timbermen and investors are now interesting themselves in these remaining virgin American pine regions with the specific idea of converting this timber supply into usable and marketable products.

THE TOPOGRAPHIC MAP OF THE UNITED STATES¹

Guy Elliott Mitchell

United States Geological Survey

THE ancient geographers invested unknown areas on their maps with fabulous and wondrous inhabitants—giants, strange and terrible animals the like of which man has never seen, vast and impenetrable regions, stupendous mountain ranges, and other features indicating in reality the scope of the imagination of the map makers.

Much of the United States was not so long since a *terra incognita* and even well within the recollection of the present generation, the West held many wild and unexplored regions of large dimensions, peopled with hostile savages and wild beasts reported to be even more dangerous, and whence returned travelers brought wonder tales only a little less unbelievable than the picturings on the maps of the ancients.

This condition has passed. There are no large areas that have not been explored and reported on, and none where the present-day explorer may expect to encounter unusual and unknown dangers or hope to discover new empires. All the highest mountains have been climbed and the worst desert areas have been penetrated; moreover, most of them have been accurately mapped. Regional explorations will continue to uncover unknown resources, but the map student can now look forward with some confident expectation of soon being able to study a reasonably accurate,

large scale map of the United States. Such a study will, however, be possible only through the completion of the topographic mapping of the country, and it is in connection with this important engineering project that we can now see daylight ahead. The topographic map is the only one on which all the physical features of the country are shown, and the making of this map is one of the major activities of the United States Geological Survey—the great topographic map of the United States. For more than 45 years the work has progressed—much too slowly, it is true, to suit the map users, including the students of economic geography—yet some 40 per cent of our two-billion acre country has been so mapped, and the outlook now is increasingly bright for a much more rapid advance in the future and even the possible completion of the other 60 per cent within the next 30 or 40 years.

There is small room for argument as to the need for the maps or the desirability of speeding up topographic mapping; indifference or opposition is only the result of ignorance of the dollars and cents value of the map to any and all communities. If the unmapped area is unsettled or unknown there is urgent need for the topographic map to reveal its undeveloped resources; if it is thickly settled—and there are some well-settled, populous States where the topographic map is almost unknown—there is all the more need for the map as a base and a guide for every

¹ EDITOR'S NOTE.—So important to all sound work in geography is a basic contour map that ECONOMIC GEOGRAPHY wishes to call particular attention to this article.

engineering and industrial project in progress or contemplated.

The recent great flood of the Mississippi River brought to light the astounding fact that only about 13 per cent of the vast area of the Mississippi drainage basin has been topographically mapped on a scale adequate for an intelligent study of the flood problems of the river and its

Coast and Geodetic Survey, describes the topographic map as the only map on which all features are properly coördinated and states that such a map is essential to the study of flood control, irrigation, soils, forestation, and development problems on a large scale and is of great material assistance in road building, water-power projects, and other engineering proj-



FIGURE 1.—One of the earliest topographic and geologic parties of the United States Geological Survey in the West—where the United States Cavalry was an escort as protection against Indians—nearly 50 years ago. (Courtesy of U. S. Geological Survey.)

tributaries. President Hoover was quoted as stating that if topographic maps of the flooded areas had been available showing with certainty the nearest higher lands to which livestock and other movable resources could have been taken, the saving of property thus made possible would have been sufficient to pay for the cost of mapping the entire flooded area. In his last report the late Col. E. Lester Jones, Director of the

ects of national importance. The total cost of the completion of the topographic map of the United States and the necessary antecedent control surveys could, he says, be charged with economy to any of these projects. Dr. George Otis Smith, Director of the United States Geological Survey, is naturally a strong advocate of the topographic map. He refers to it as a "master" map and says in a recent annual report that "a topo-



FIGURE 2.—It is a far cry from the survey of these vast Southern Swamps to that of Death Valley Desert. (Courtesy of U. S. Geological Survey.)

graphic map often pays for itself in the saving made possible in the selection of an easier railroad cut-off or a shorter highway route, and a single oil pool located by means of a new topo-

vealed itself to an engineer solely from his study of the topographic map of a drainage basin and the stream gagings of one or more rivers, and through the development of that



FIGURE 3.—United States Geological Surveyors beside the lowest point in the United States—Death Valley. (Courtesy of U. S. Geological Survey.)

graphic map may outweigh in value to the country the year's total appropriation for topographic surveys for the entire United States. Or a great power project may have re-

project the industries of several States will benefit for centuries."

Why is the topographic map the best, the only general-purpose map? Because it is a contour map. In



FIGURE 4.—Along the “bottoms” of the Sacramento River, California. (Courtesy of U. S. Geological Survey.)

addition to the contours it is the best and most accurate map that the Geological Survey can make, but it is the contouring that makes it unique in its engineering value and, incidentally, that makes it cost many times as much as a map of any other kind. By means of the contours the map presents to the engineer an accurate three-dimension picture in miniature of the country in which he is interested, and whether his task is to drain a small farm area or to lay out a great railroad system or a huge water-power or irrigation project, or to plot an economic survey, the topographic map becomes his bible. Spread out on his table it is in effect an exact model of the one square mile or the thousand square miles of territory he is considering. The shape and the height of every mountain and hill, of every slope and valley, are beneath the sweep of his eye, and he traces the accurate gradient of every stream. He can run a line or route with his pencil in full confidence that a detailed survey will simply verify his preliminary estimate.

Everyone has been impressed with the absolute integrity of the Government topographic mapping. Topo-

graphic engineering parties were engaged in mapping areas in the West where it seemed that livestock grazing was the ultimate industry and where there was no sign of useful minerals or prospect of any possible economic development for a century. The mapping was carried on with an absolute fidelity to accuracy and detail as though a horde of prospectors and engineers were expected to flock through the country the succeeding season.

Accepting, then, the value of the map, one may ask what the actual prospects of the completion of the topographic surveys in the United



FIGURE 5.—Topographic engineers on one of the high points in the Rockies of Colorado. (Courtesy of U. S. Geological Survey.)

States during the lifetime of the average reader? About \$22,000,000 has been spent on the surveys and maps already made. A considerable part of this amount has been fur-

nished by the States coöperatively. About \$50,000,000, it is estimated, will be required to complete the new surveys and make resurveys of many areas where the scale of the original mapping was too small or where the work done was not up to present-day standards and requirements. Several years ago the American Engineering Council, which represents many engineering organizations, finding that it would take over a hundred years to finish the topographic sur-

year to year and place at the disposal of the United States Geological Survey for making standard topographic surveys. As this information has spread throughout the country, it has stimulated a number of States to authorize and make continuing appropriations that will complete the mapping of those States in relatively short periods. For instance, Maine, which is at present only 37 per cent mapped, last year authorized continuing State appropriations which



FIGURE 6.—Topographic survey party in what is now Glacier National Park. (Courtesy of U. S. Geological Survey.)

veys of the United States at the rate they were then being made, persuaded Congress to pass the Temple Act, which authorized annual Congressional appropriations sufficient to complete the map in about 20 years. But, under the present budget régime, authorizing appropriations and making appropriations are two different things; however, the Appropriations Committee has stated in general terms its policy to meet dollar for dollar any appropriations that States or municipalities may make from

have enabled the Geological Survey to lay out a mapping program that should, under the Federal policy of matching State appropriations, complete the remaining 63 per cent within the next seven years. Similarly New Hampshire's remaining 34 per cent of unmapped area may be expected to be finished in about three years.

Other States are becoming eager to have their areas mapped, and it is presumed that there will be a constantly increasing number following this progressive policy. Nine States

are already completely mapped—New York, Connecticut, Rhode Island, Ohio, West Virginia, New Jersey, Maryland, Delaware, and Massachusetts. The three New England States mentioned, New Jersey, and Maryland have all been completely mapped for years. So, also, has West Virginia, owing to the foresightedness and energy of the late Dr. I. C. White, and Ohio was completely mapped about ten years



FIGURE 7.—Engineer inking in a topographic map. The original field, plane-table sheet, when inked, serves as final copy for the engraver. (Courtesy of U. S. Geological Survey.)

ago owing to the persistence of Prof. C. E. Sherman, when State Engineer, in appearing before the Ohio legislature every year and insisting on a coöperative appropriation to speed up what he considered an engineering job of prime importance to Ohio. New York State has just been completed—a task of 40 years—and her State Engineer is now arranging with the Geological Survey to resurvey some of the earlier mapped sections. The immense area of the State of California is nearly 80 per cent mapped and the State has to date spent some \$500,000 of her own money for this work in coöperation with the Federal Geological Survey. Massachusetts was the first State to

be completely mapped—on the scale of one inch to one mile—but she is now considering having her whole area remapped on the much larger scale of two inches to one mile which would make a map of Massachusetts four times the size of the present map—a huge map 30 feet broad and 15 feet high—on which every possible detail of physical geography would be shown, as well as all the works of man. Economic geography covers a wide range, but adequate study of it must be based on a physical map. Without such a map the economist is in much the same position as a mariner at sea without chart or compass.

Under the present program of the United States Geological Survey every springtime sees some 150 highly trained topographic engineers and their engineering assistants fare forth into all corners of the country—from New England to Florida, and from the Carolinas to California—each bent on contributing a perfect topographic sheet or section to the great topographic map of the United States. In the Eastern States the men avail themselves of some of the advantages of civilization, but in the West they may camp out for the entire season. No time is lost each day in getting on the job. The 9 to 4:30 Government hours are forgotten and the work is carried on from daybreak to dark. Even then the engineer works several hours additional by lamp or lantern light. When the whole technical force is in the field the personnel is more than doubled by the addition of teamsters, truck drivers, rodmen, and camp cooks.

Each party works the season through, sometimes in a single locality, oftentimes in several with numerous changes of camp, until the snows of winter drive the men in;

then, when no more work can be done, the engineers return to Washington and ink in their maps which have been drawn in pencil on the ground. When these maps are inked, they are engraved on copper plates, and each one represents at this stage an expenditure by the Geological Survey of \$5,000 to \$15,000, according to the character of the country surveyed. Then, the maps are printed in the Geological Survey's big printing plant and are ready for issuance to other Government bureaus and for sale to the public at the nominal cost of printing and paper—10 cents apiece or 6 cents in small wholesale lots.

Adventure is by no means lacking in the field work of topographic mapping, which takes the engineers into the most remote, often almost inaccessible, corners of our country. This, however, is another story, and not an easy one to write, because the old Government field man who has had the worth-while experiences as a rule takes adventure so lightly that he rarely mentions it, and troubles and even dangers that to ordinary "explorers," campers, and others who might be "roughing it" would inspire many thrilling accounts of hardships overcome, are soon forgotten. It is all in the day's work with the seasoned Government man and real adventures are either never mentioned or if they relate to the work are dismissed with a mere line or two in a monthly report to headquarters.

It may be added that the topographic map is not purely an engineering map; it is as fascinating to the hiker or the non-technical man as it is to the specialist. Anyone a bit interested in the surroundings of the place where he lives may send to the Geological Survey at Washington

and ask for a free index map of his State, and from it he can order his 10-cent local topographic map and among other things locate his individual house and see just how high it is above sea-level, also the air-line distance to any neighbor's home. The map will authoritatively settle all disputes as to distances or the altitudes of different points.

Garrett P. Serviss, whose popular writings some of us see from time to time, in commenting on the wealth of interesting information found on the topographic map of his boyhood home in central New York State, says: "I can find the old schoolhouse at the crossroads, with the hill above it behind which the sun set, and the higher hills to the south where the July thunderheads gathered and darted forked lightning, and the deep valley of Irish Creek, where the slate pencil rocks were found, and the steep glen to the north called the 'gulf'—fearful to the childish heart—and the tree-crowned precipices on the east that pitched down to the dark waters of the Schoharie where the stream paused and flowed ominously black with depth around Pettingill's Bend, and the lap of land projecting like a little peninsula, with bosky hollows on either side, where the Indian was uncovered in his grave by the long years of eroding rain, and the swelling form of Bean Hill across the Schoharie, on whose broad flank the fenced farms with their varicolored fields looked like a colored map in the geography book."

This throwback to olden times by Mr. Serviss has so caught his fancy that the author has gotten out the topographic map of his own home town, Hudson, on the Hudson River, and its picturings bring back vividly to his mind quite as many interest-

ing things about his own boyhood observations and little adventures. For instance, at the age of 6 years the author looked upon Mount Merino, just south of Hudson, as a vast and lofty mountain which he several times climbed with some pride to se-

cure a supply of the sweet birch bark from the trees growing on its higher slopes. The map before him shows an easy ascent with the summit of this huge mountain of childhood's remembrance 548 feet above sea level and 528 feet above the Hudson River.

AGRICULTURAL REGIONS OF SOUTH AMERICA

INSTALMENT VI

Clarence F. Jones

Economic Geographer, Clark University

PACIFIC MARGIN TROPICAL PRODUCTS REGION

THE Tropical Products Region of the Pacific littoral embraces a strip 30 to 140 miles wide and extends from $3\frac{1}{2}^{\circ}$ S. latitude to 9° N. In the south the hot dry desert of Peru grades off gradually into the hot humid Guayas lowland and adjacent slopes. The eastern boundary zone lies on the western flank of the Andes, near a transition between subtropical and temperate products. Farther north the eastern boundary extends to the Caribbean along the Sinú River, and marks the transition from the more moist heavily forested areas west of the Sinú region to the more open forests and savanna lands of the Bolívar plains.

Except for a small district tributary to Guayaquil, the region is one of little agricultural development. It consists of an area of primitive forest agriculture and grazing, and of desultory gathering and preparation of forest products. Though it produces a variety of commodities, only cacao, tagua nuts, Panama hats, and coffee have risen to commercial significance. This low status of agricultural activities, in general, grows out of the combination of social, economic, and physical conditions. Except for southwestern Ecuador the region is fairly rough, very hot, rainy, and covered with exuberant vegetal growth, which readily satisfies the simple wants of primitive folk and at the same time erects a barrier against

marked agricultural expansion. The backward bush negro and the forest Indian, obtaining food without much mental or physical effort from a patch of corn, cassava, a few fruit trees, and fish in the many streams, find life too easy in the shelter and shade of pole-palm thatched hut. Also, with transportation for the whole area confined to dug-outs or small steamers on a few short navigable stretches in the small rivers, to human porters along wet and muddy forest paths, and to a few coastwise steamers (only two railways cross the region and most of the regular line steamers from Panama to the West Coast of South America pass up the coast of Colombia and Ecuador), these people have no incentive or desire to laboriously clear away tropical forest to increase their patches of corn, sugar cane, or cassava in the face of dominating physical conditions.

THE ENVIRONMENT

The area included in this region is one of varied relief, drainage, and soil types. Two types of land border the sea: (1) At intervals are the low flat coastal strips and broad deltaic plains of the larger rivers as the Guayas, Cayapas, Esmeraldes, Mira, Dagua, San Juan, Atrato, and others; consisting chiefly of unoxidized, cream-colored, and white, stiff clay and sandy clay of considerable depth these permanently watersoaked flats, useless for agriculture, are dense mangrove forests; they are bordered

by low hills and fresh water swamps near the deltas; (2) in other stretches between the mangrove swamps the coast is bordered by sandy ridges, marine terraces, or mountain spurs rising abruptly from the water's edge.

Adjacent to the coastal lands rise the broad sandy ridges or table lands as in western Ecuador and the rolling to rough rounded hills as in the Colombian section. Through the hilly belts soils of friable red clays from 2 to 5 feet deep favor a variety of crops where the slopes are not too steep. Farther inland rise the western Cordillera, the flank being deeply carved by the numerous streams that plunge from the higher parts. At the base of the Andes and along the middle courses of the larger streams are the large sloping plains, the chief agricultural lands of the entire region. They include: (1) The Santo Domingo-Bucay Belt in Ecuador, 1,000 to 1,700 feet above sea level, an area of fine mellow sandy loam alluvial soil with a good supply of humus and well-drained in general. (2) The Palenque and Daule plains, low river plains, with slight rises of ground here and there; these plains with imperfect drainage and belts of heavy black clays and clay loam soils of lighter color, produce a variety of products, but are not suitable for cacao. Here trees lose their leaves and grasses dry up during the dry season. (3) The lower Guayas Valley occupied by heavy gray and black stiff clays, support a scattered growth of acacias, but they are valuable for rice culture and a variety of native grasses as well as Para grass. (4) The middle Mira Valley, an important cacao region of rolling, well-drained, brown clay loam soils. (5) The middle portion of the San Juan, a rolling to hilly country of red clay soils of good fri-

bility and drainage, a district of a variety of local crops. (6) The middle portion of the Atrato plain; though much of this plain, 22 miles long and about 35 miles wide, consists of low swampy alluvium of heavy clay unsuited for tillage, natural levees of high banks for miles afford fertile strips of soils for cacao and sugar.

In contrast to the varied conditions of relief and drainage, climatic conditions, somewhat more uniform, lend unity to the region as a whole. Under the full influence of the tropical sun, temperatures are always high, even on the intermediate slopes of the western Cordillera. In the low regions temperatures range from 72° to 93° F., promoting a rapid and luxuriant growth of vegetation, except in dry southwestern Ecuador; at 2,000 feet on the slopes temperatures range from 58° to 93° F. In rainfall greater variations exist. In western Ecuador from the Equator south extends a dry, almost desert region, which receives from a few inches to nearly 60 per year. Most of this falls in the season from December to April, the remaining months being almost without any rainfall. Farther east in the Guayas lowland at Guayaquil, precipitation amounts to 90 inches per year or more and the dry season is shorter and less marked, for showers may come even in the driest months. To the east of the Guayas River lies a heavy rain zone on the Andean foothills and the middle slopes; 90 to 110 inches fall during a year; even the driest months, July and August, get drizzling rains that last from 6:00 P.M. until 7 or 8:00 the next morning; it is a belt of constant clouds and fogs drifting up the slopes and valleys. Northward in Colombia the precipitation increases to nearly 300 inches at Buena-

ventura and in the San Juan Valley; heavy rains fall every day; no dry season decreases the high humidity; vegetation is drenched and the soil water-soaked. The rainy humid conditions prevail also in the Atrato Basin.

Vegetation types correspond closely to drainage, soil conditions, and amount and distribution of precipitation. The low swampy coastal and deltaic plains support dense mangrove swamps. Except for coconut palms few other trees invade these stretches. Low areas of stiff clay lands and areas of marked seasonal distribution of rains consist of savanna lands of native and Para grasses with here and there a scattered growth of acacias and groups of graceful palms. In the arid portion of western Ecuador xerophytic types dominate; here the giant cactus (*Cactus opuntia*), thorn bushes of many types, algarroba and its relatives (*prosopis* and *mimosa*), *palo santo* and several grasses particularly clothe the sandy ridges, valleys, and table lands. But, from the Equator to the Caribbean and from the mangrove swamps to the Andean subtropical zone around 5,500 feet, the region supports a verdant tropical rain forest, rich in species, generally dense in stand, and providing many of the products of the region. In addition to tropical hardwoods are jungles of tall bamboo supplying the materials for negro huts; the coconut palm; the *phytelephas macrocarpa*, producing tagua nuts; the rubber tree (*Castilla elastica*); the *toquilla* palm (*Carludovica palmata*), furnishing the fiber for the Panama hat; *bomba ceiba* or the silk-cotton tree yielding kapok; bananas, plantains, mangoes, breadfruit, cacao, coffee, and other fruit trees. Thus, the richness of the forest in use-

ful products lends character to this Tropical Products Region (Fig. 100).

AGRICULTURE

The agricultural enterprises include the production of a few commercial crops in a few districts, the growth of a variety of subsistence



FIGURE 100.—The base of the ceiba tree. This tree, the monarch of the low humid forest, yields kapok. (Courtesy of Nels A. Bengtson.)

crops in these areas and by all primitive folk scattered along the banks of the rivers, and grazing in some sections. Cacao is the chief export crop, though cotton and coffee serve as money crops in a small way.

Cacao

The dominant commercial crop of the region, cacao, is grown in several parts of the area by two methods. In the Colombian section and part of Ecuador along well-drained river valleys and on lower slopes up to 3,000 feet elevation where wild cacao (*Cacao silvestre*), the brushwood and trees are cut down, except for a few high-crowned trees left for shade. In these areas cacao receives only periodical weeding, brushing, and harvesting by the backward negro population. But, much of the output of the region comes from cacao planta-

tions (*Theobroma cacao*), cleared and planted orderly in the Esmeraldas region, the Guayas and Daule valleys, and adjacent foothills of the Andes. In these areas more than 6,000 large estates with more than 100,000,000 trees embrace some 250,000 acres.

For a long time these plains and slopes dominated the world's output and market of cacao, contributing one-third of the total as late as 1900, but less than one-tenth in 1928. Although it led all other districts until a few years ago, no new plantations have been established for years; all the trees are old, and antiquated methods still rule.

In these plains of heavy fertile alluvial soils and slopes of clay loam soils, fairly good drainage, temperatures ranging from 70° to 93° F., more than 70 inches of rains well distributed throughout the year, a short, less rainy season of abundant sunshine, and an absence of strong winds favor the growth of big yields of high-quality cacao. Cheap Indian labor aids the industry on the extensive plantations. Since little care is given the trees except to provide some shade for them and chop out the underbrush while they are small, not a great deal of labor is required except at harvest time. Although some fruit ripens all the year, the three different crops—the principal (or winter) crop harvested from February to April, the summer crop from July to October, and the Christmas crop from November to January—equalize the flow throughout the year, an advantage not enjoyed by some cacao regions. River barges or boats afford cheap transportation to ocean vessels at Guayaquil. On these cacao estates, some under foreign control, profits have been high,

mounting to as much as from 15 to 25 per cent on the investment during the peak years of the industry.

But, extensive areas of virgin lands, with exceptionally favorable conditions for the growth of cacao, lost their rank. The planting of new areas did not keep pace with world demands; many of the owners of plantations resided in foreign countries, living on the income from their huge estates, which they intrusted to a manager who cared little for the future of the property. As the increasing price of cacao gave big incomes even with decreasing yields, the owners made very few new plantings. Moreover, foreign companies with sufficient capital necessary for the establishment of whole new plantations, not being able to get satisfactory assurance of favorable financial policies went elsewhere to invest in cacao production. The natives, under poor supervision, harvested both ripe and green beans, and neither sorted them carefully nor dried them properly, thus producing an inferior commodity which injured the market. Increasing export duties made competition with cacao from new regions more and more difficult; in a recent year taxes of one kind and another totaled two cents per pound on exports.

Furthermore, on the crest of the period of greatest prosperity in the industry, from the high prices of the first years of the World War, the monilia disease, which attacks the fruit, broke out in 1916 and caused great losses. In June, 1922, the witches'-broom disease, which attacks the trees, broke out, spread rapidly, and caused the abandonment of many plantations. It has spread to most of the properties in the Guayas and Machala regions, the chief

districts, and threatens to wipe out the entire industry. Exports from Ecuador decreased to 42,000,000 pounds in 1928, nearly to the level of the shipment of twenty-seven years before.

Aside from experiments by individual growers little or nothing is being done to combat the witches'-broom disease. On many of the older plantations it is not practicable to prune the trees, thin out the shade, and remove the abnormal growth of witches'-broom because of the great size of the trees, their closeness together, and the lack of sufficient labor. Several of the largest estates, lying at the base of the mountains and nearly always shrouded with clouds and mists, face complete ruin, since some sunshine each day is necessary in checking the disease. Even on the newer plantations away from the mountains it may not be profitable to spend large sums of money to fight the witches'-broom and then have to market the product in competition with that from regions favored by natural and economic conditions and free from diseases.

Coffee

Though far less important than cacao, coffee stands as the second commercial crop. Grown in several parts of the region of the western flank of the Andes up to 5,000 feet, the major portion of the yield comes from large plantations in a zone in southern Ecuador, east and south of Guayaquil on the steep slopes of the Cordillera. While good drainage, fertile red clay soils, climatic conditions, and nearness to ocean transport favor the production in this area as well as in other portions of the Pacific littoral of a good quality coffee for export, a lack of dependable labor, capital, and machinery, the

low quality of the product, resulting from poor methods of preparation, and competition with areas better favored in many ways may hinder any significant extension of coffee culture in this region for all time.

Cotton

In a few places cotton has become a significant commercial crop. The chief areas of culture lie in the Upper Guayas region, in Esmeraldas, and the more arid sections of Ecuador where some perennial tree cotton grows. Farther north too much rain, high humidity, and backward people keep cotton out of the Pacific littoral except for mere patches or strips along river levees. With poor methods of cultivation and little care in picking and preparation, the output in Ecuador is not large; even here late rains often damage the crop greatly. A bale to the acre is considered a good yield for this region under present conditions. Like coffee, cotton culture promises little for the near future.

SUBSISTENCE CROPS

On all the large estates as well as in the little forest clearings in the Colombian section, the people produce a variety of subsistence crops. They include sugar cane, corn, cassava, rice, beans, bananas, plantains, mangoes, bread fruit, coconuts, and others. Producing abundantly on fertile soils, with high temperatures and copious rains, they are confined for the most part to small patches in proportion to the needs of the sparse backward population. However, sugar cane occupies large areas in the Guayas lowlands, where stand the most modern centrals, and along some of the northern river valleys; for miles along the Atrato and San

Juan tall sugar cane fields line the narrow natural levees. Everywhere with one planting the cane yields several cuttings. In addition to supplying an important article of food, it provides alcohol and rum in large quantities.

In the production of all these subsistence crops the crudest of methods prevail. On large plantations they are planted between rows of cacao, coffee, and cotton or around the laborers' huts; in the forest clearings

state. The forest negro tends no animals. He provides his meat from the waters of the rivers or the forest solitudes. On the other hand, the inhabitant of the arid thorn bush country of southwestern Ecuador places almost complete dependence upon his herds of goats, a few swine and cattle (Fig. 101). Much of this arid region, parcelled out in vast ranges, provides fair pickings for the hardier animal. Here a man's wealth is measured not in hectares of land



FIGURE 101.—St. Vincent near the seacoast on the Santa Elena Peninsula, southwestern Ecuador; a strip of coastal country about as dry as the Peruvian desert farther south. (Courtesy of Nels A. Bengtson.)

they grow among stumps or dead trunks of recently burned forests. They get no cultivation. The machete and the hoe are the only implements employed. Since primitive methods in a fruitful region produce sufficient food for the backward forest dweller, he prefers to loll around half naked in the shade and shelter of his crude pole-palm thatched hut, or glide down a tropical stream in a dug-out catching fish, than to laboriously till the soil.

GRAZING

For the region as a whole the grazing industry rests in a backward

possessed but in the numbers of goats and cattle that he keeps; the family home, more often than not, consists of a house perched on high poles in the goat pen. Ranges of exceedingly low-carrying capacity support only animals of low-grade.

The better grazing lands line for miles the low flat lands, of heavy clay soils, along the lower Guayas and other rivers of the region. Here large areas of savanna lands of several tall native and Para grasses provide plenteous forage for many cattle. But, the industry suffers under many handicaps characteristic of most tropical savannas: hard, coarse

grasses during the dry season, Texas fever tick, hoof-and-mouth disease, numerous flies and mosquitos, low-grade cattle, lack of modern methods of breeding and grazing. The low-grade cattle supply in the best of flesh an inferior meat; in many sections they serve chiefly as draft animals. As with crop production few conditions point to advance in the grazing industry, as a living for the backward population is too easily obtained by primitive culture and by the desultory gathering of forest products.

FOREST INDUSTRIES

Though the region possesses large stands of valuable hard woods, they are little exploited owing to the low-stage of life in the better-forested districts, the meagre transport facilities within and from the region and the existence of large areas of valuable hardwoods nearer to the temperate consuming regions. Forest industries in this littoral consist of the gathering and preparation of several forest products (Fig. 102).

Tagua Nuts

Tagua or vegetable ivory has long been an important product of this region. The *tagua* palm (*Phylephas macrocarpa*), a stunted palm fern 10 to 20 feet high, which grows wild in the tropical forests of western Ecuador and Colombia, produces the vegetable ivory of commerce, a valuable commodity for an essential item of wearing apparel. The fruit, similar to the coconut, grows in from four to nine drupes to the tree; each drupe, about the size of a man's head and weighing nearly 20 pounds, consists of a woody, fibrous, wart-covered wall that incloses from twenty to forty seeds. The nuts are of hard

white composition, fine-grained, and approximate real ivory in all characteristics.

After the fruit ripens, the drupes fall to the ground and usually burst open, the nuts either falling out or sticking in the fibrous pulp. Ro-



FIGURE 102.—The heavy tropical forest about thirty miles west of Guayaquil; these forests supply the many products that give character to the Pacific Margin. (Courtesy of Nels A. Bengtson.)

dents and other wild animals, fond of the pulp, eat it and clean the nuts, or natives beat the heads of the fruit and then gather the nuts; natives go into the deep tropical forests for days at a time in search for the *tagua* trees, which are widely scattered through the forests. The chief areas of gathering include the Atrato, San Juan, Dagua, Mira, Esmeraldas, Cayapas, and many smaller valleys. The nuts are brought out on the backs of natives, on mules, or in small boats. Unripe nuts gathered from the trees have a red tinge and bring lower prices than ripe ones do. The tree produces fruit the year round, but the principal crop comes during the months from January to May; many unripe nuts are gathered from Octo-

ber to December. The tropical fruiting throughout the year gives a fairly even flow of nuts to the markets.

Although the region supplies nearly all the world's vegetable ivory, a marked expansion in the industry is not to be expected. Vast areas of tropical rain forest favor the growth of the *tagua* trees on plantations, but the low value of the product prohibits the establishment of costly plantations and restricts the output to the activities of the native *tagua*-gatherers. In recent years of high prices it has been difficult to secure sufficient numbers of natives to go into the forests to collect nuts. Lazy negroes reluctantly sacrifice leisure even to gather *tagua* nuts. The industry depends upon very cheap labor and transportation. Furthermore, world demands and prices may not rise appreciably above the level of the past few years.

Toquilla Palm Fiber

Of long standing the gathering of toquilla palm fiber (*Carludovica palmata*), for the fabrication of Panama hats, hammocks, straw cigar holders, and other articles, occupies the attention of many people in different sections of the region. The palm, presenting the appearance of diminutive fan-shaped trees without a trunk, attain a height of 6 to 10 feet in the heavy fertile soils of the lowlands and hot humid slopes up to 5,000 feet. It thrives chiefly in the wild state, though in some sections it is planted. The fan-shaped leaves 5 to 7 feet long must be cut from the tree before they open; then stripped of their outer filaments, they are repeatedly dipped for a few seconds in a vat of boiling water, dried in the shade and a day or two later the straw or fibers from the leaves are

bleached in the sun, when they are ready for weaving.

The hats are woven chiefly by the women and children, who become skilled in the art. It takes days or weeks to complete a hat, since weaving is commonly done only in the early morning hours or in the evening, when atmospheric conditions favor the making of the best Panamas.

The industry is centered in the provinces of Manabi and Guayas, Ecuador—the famous Monticristi and jipijapa hats originating here—but hats are made in many of the towns of the lowlands of the region and in those on the western slopes of the Andes; the industry even extends into the Central Andes of Colombia. Hats woven in remote villages are bought up by native traveling buyers who deliver them to the exporting companies, which ship them to all parts of the world, especially to the United States and Europe. Also steady demand for them exists in South American countries where they are worn by all classes of people.

This region for a long time produced the entire output of the world, but the *toquilla* palm has been introduced into Panama and Honduras, where its production forms the basis of a small industry. Foreign countries importing the straw have also begun to make hats which compete with the Ecuadorian and Colombian products. Decreased shipments from the region have resulted in recent years from this competition, from imitation, and from the import duties which various countries have placed on them, thus raising the price beyond the means of the average person. The output of the region might be increased greatly as a result of better organization and more laborers. As it now stands,

most of the cost of the hat is attributable to native hat jobbers, to importers, and to merchants' fees, and not to the long hours of painstaking labor required to weave it, for the patient Indian or mestizo, who laboriously weaves the hats, receives a dollar or two apiece for the common ones; yet these same hats sell for twelve to twenty-five dollars in the United States.

Rubber

Caucho rubber, the product of the *Castilla* tree, constitutes the only

the lower flanks of the western Cordillera are favorable for plantation rubber, and some plantings of rubber were made between 1902 and 1911, the results were not satisfactory and the cultivation was given little attention. Consequently the region produces only wild rubber. Increasing quantities of this rubber may be gathered during periods of high prices, and some reaches the ports even in times of low prices, since many natives who have other means of support produce rubber as a side issue to their chief occupation,

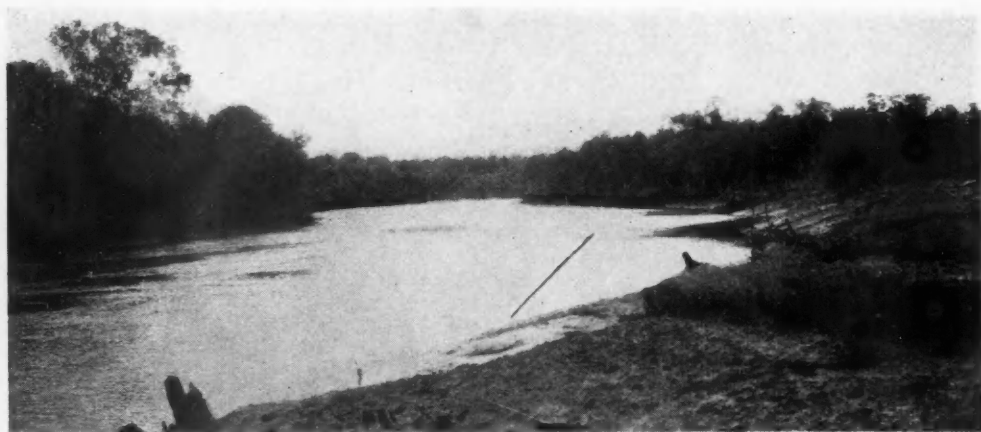


FIGURE 103.—A placid stream in the tropical forest country with a precipitation of approximately 90 inches per year. In these areas the Indian or mulatto prefers to glide down the quiet streams and catch fish than to tread weary slippery trails in search of rubber or other forest products. (Courtesy of Nels A. Bengtson.)

rubber of commercial importance, in spite of the fact that rubber plants of many kinds thrive in the lowland forests of the region; and extend well up the slopes of the Andes; the trees grow in all parts of the area on lands above permanent flood level up to an elevation of near 2,500 feet; they do best on red or yellowish clay hills and slopes. The chief areas include the middle and upper portions of the Guayas, Esmeraldas, Mira, Dagua, San Juan, and Atrato Valleys.

Although considerable areas on

although it may yield little or no profit. *Castilla* trees formerly found in large numbers in several of the valleys have disappeared except in remote and isolated districts. This is especially true of the Atrato and San Juan region. During the years of the great rubber boom in 1909-1912, just before cheap plantation rubber from the Malay Peninsula entered the world markets in sufficient quantities to cause a sharp drop in the high prices, large shipments moved out of the region.

The region may continue to export small amounts of wild rubber, but it seems that little future for either the wild or the plantation product exists so long as present conditions of destructive methods, of backward forest folk, and of uncertain finance and politics prevail, because the long-time investments necessary in establishing rubber plantations require political assurance of definite policies and economic stability, and because an active wild-rubber export depends upon unusually high prices owing to

tolu, others producing resins of medicinal qualities or waxes for industrial purposes, and the *ceiba pentandra* which yields kapok. As with rubber gathering, there exists little organization in these activities, the work being carried on in a desultory, careless, and seasonal fashion by the mulattoes and negroes of the river valleys, who have preempted large areas of forests adjacent to their settlements and who control the gathering over forest trails kept open by machete. Under these primitive



FIGURE 104.—Looking down from a hydroplane on an almost unbroken tropical forest of the Pacific lowland of Colombia. Here the forest inhabitant leisurely passes away the day desiring not to clear the forest for crop or pasture land when woods and streams give him sustenance. (Courtesy of the Scadta.)

the cost of gathering and shipping it with poor transportation facilities and unsatisfactory labor (Fig. 103).

Other Forest Products

In the areas growing the *castilla* and the *tagua* palm are many latex and resin-bearing trees and vines, giving rise to a forest-gathering industry. Among the more important are the *nispero*, which supplies balata, the *lirio* yielding a substitute for chicle, the *balsam copaiba* and *balsam*

conditions there can be little advance. More likely, trees will be overtapped and the output after a number of years will decline.

THE FUTURE

Most of the Pacific Margin Tropical Products Region suffers under a series of handicaps which deter marked expansion. Arid southwestern Ecuador promises little. Cacao declines under competition from other areas, from ravages of dis-

eases, from inability or the indifference of owners to provide better methods and check diseases. In other areas mulattoes, negroes, and Indians spending a life of ease with their pole-thatched hut, patch of corn and cassava, a few fruit trees, and a forest gathering industry of some type, possess no incentive to increase output of forest products, to clear away laboriously dense forest in order to produce crops they cannot market, and to sacrifice leisure, their most coveted luxury (Fig. 104).

GRAZING, FARMING, AND FOREST AREAS OF NORTHERN COLOMBIA

In northern Colombia eastward from the forests just west of the lower Sinú stretch a number of grazing, farming, and forest districts. They comprise (1) the tropical savannas of the Sinú, the Bolívar plains, the lower San Jorge, the lower Cauca, and the middle portion of Rio Cesar, (2) the Caribbean sugar and cotton district, (3) the general farming and grazing district of the lower Magdalena, (4) the areas of tropical forests and primitive agriculture, (5) the banana and coffee districts of the Sierra Nevada de Santa Marta, (6) the arid Goajira Peninsula, and (7) the Sierra de Perijá (Fig. 105). All the districts, except for the higher parts of the Sierra Nevada de Santa Marta, have tropical temperatures. In the Magdalena and other valleys the daily temperature often reaches 95° F., night temperatures may drop to 70° F. In the more arid sections the range is somewhat greater. But, in other physical conditions, the districts show marked contrasts.

As a whole, northern Colombia is a region of sparse population, with a few centers of concentration. The people, except for a few commercial

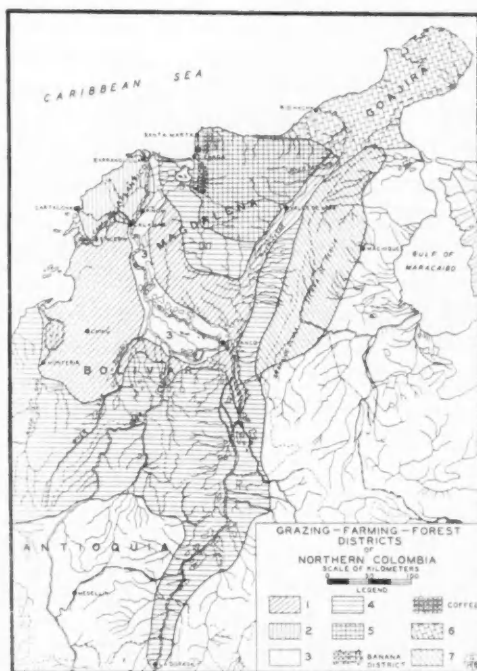


FIGURE 105.—Northern Colombia, a region of sparse population, as a whole exhibits a variety of conditions in land use.

men and land-owners, consist of mulattoes and forest Indians, suffering from tropical plagues and living with only the bare necessities of life. They possess little incentive or capital for agriculture or cattle raising on a modern scale. Only along the Magdalena and south of Santa Marta do even good transportation facilities exist; other sections are remote and isolated, being materially handicapped in all agricultural enterprises.

SAVANNA GRAZING LANDS

The savannas of northern Colombia, in some respects the best grazing lands of the country, lie in two great regions. One stretches from the low lands along the Sinú across Bolívar to the Magdalena farming strip and north to the Sugar-Cotton Region of Atlantico and northern Bolívar and

Magdalena. The other area lies along the middle Rio Cesar and Valle de Upar southeast of the Sierra Nevada de Santa Marta. Though cattle are found in all districts of northern Colombia, where people live, most of the cattle are grazed in these two large regions. In farming areas they serve as the chief draft animals, but on the savannas their principal use is for meat; in both areas quantities of milk, butter, and cheese are used. Physical conditions, though not ideal in many respects, and several economic conditions contribute to the dominance of pastoral interests of these areas.

Along the Sinú, San Jorge, lower Cauca, Cesar, and smaller streams broad, low, flat pastures suffer from inundation during the rainy season, but support the best grasses during the dry season. From these flats the land rises in broad, low, graduated levels to the more rolling portion of the central part of Bolívar, the area of the largest and most numerous *estancias*. In all the savannas high temperatures prevail. But along the sea and on the rolling lands rather frequent breezes alleviate the enervating heat of the noonday sun. The annual rainfall for these lands increases from about 36 inches in the northwest, along the more arid Caribbean coast, to near 60 inches farther south where savanna grades into tropical forest. Along the Cesar rainfall averages a little more. Though having a fair allotment of yearly rain, most of the precipitation comes in the daily showers, from May to November inclusive. Sufficient for a good growth of grasses in general, the dry season brings the problem of decreased and less valuable forage and a poor water supply on



FIGURE 106.—Poor-grade cattle from the Bolívar savannas being driven to the high pastures in the central range of the Andes near Medellín.

many *estancias*. Marked variations in amount from season to season occur and cause large losses.

The low, flat lands along the streams grow a variety of native grasses and vast areas of *Para* and *Guinea*, grass introduced on lands cleared of forests. *Para* grass does especially well on these water-soaked lands, while *Guinea* finds better conditions on the *tierra firme*. Both are tall bunch grasses and supply excellent forage when young and tender, but, like the native grasses, become harsh and brittle with the approach of each dry season; yet the ranges do not become parched as those of the Campos of Brazil. They are not especially good fattening grasses. Everywhere in the savannas tall graceful palms and now and then strips or clumps of other trees rise far above the grass cover.

The developed savanna areas are those rather near to markets or lines of transport for animals. On the west the Sinú is navigable as far as Monteria, near the southern edge of the grazing area. In central Bolívar from Chinú to Calamar cattle move



FIGURE 107.—Native stock from the Bolivar savannas at one of the markets; these animals arrive at the slaughtering centers in only fair flesh. Most of them go long distances to market overland or on hot river boats.

out by coast ports, by the Magdalena or overland to the north, where they are consumed in the cities of this section, in the one modern packing plant of the area at Covenas south of Cartagena, or are exported on hoof to Panama, and the Islands of the Caribbean. Also, many move to up-river points on the Magdalena. The San Jorge and Cauca districts send cattle down the river or overland to the Medellin market 300 miles to the south (Fig. 106). The Cesar area has an outlet on the Magdalena at El Banco, while the Valle de Upar has two outlets: one west by trail to the head of the Santa Marta Railway, and the other north by trail to Rio Hacha on the Caribbean. All the *estancias* produce subsistence crops, but cattle on foot, their hides, and the large cakes of white cheese packed on mules or in dugouts, provide the only commodities that can be marketed from remote sections.

These lands possess about 2,000,000 cattle and in the northern section a few sheep, goats, and mules. The cattle consist almost entirely of old creole stock; tall, bony, and rough, they do not yield good cuts of tender

beef (Fig. 107). It requires from four to five years to bring a steer to 1,000 pounds live weight; then he will dress about 400 pounds of beef. Such a steer brings about \$40; in the Eastern Pampas Grazing Region of Argentina a steer of 1,500 pounds, giving 750 pounds of beef, can be grown in $2\frac{1}{2}$ years and sold for \$55. Thus a grower in the Pampa can produce in the same length of time three times as much beef of far better quality and realize nearly three times as much money as the cattleman in this region.

Though possessing a series of favorable physical conditions the industry suffers under serious handicaps. Some blooded bulls have been imported, but, for the most part, they have succumbed in a short time to disease and pest for want of proper care. No care is bestowed on the animals; cows, steers, and bulls graze together, the cows dropping their calves in the open. Grazing on large ranges, they may be moved to fresh pasture from time to time. In only a few places are animals corralled at night. Seldom are they dipped to kill ticks, thick in the savannas, or inoculated for protection against diseases, except anthrax. In a region where strong large steers stand at a premium for draft animals, many cattle killed consist of cows and heifers; in some sections three out of five killed are cows and heifers; this deters expansion.

The cattle raising sections produce subsistence crops; physical conditions favor a more extensive tillage of some crops, but the meagre transport facilities, small and inefficient population, and lack of a growing market, contribute to the permanency of the grazing industry in the savannas.

THE CARIBBEAN SUGAR-COTTON DISTRICT

In northwestern Magdalena, central Atlantico, and northern Bolivar the cultivation of sugar and cotton assume the dominant rôle in agricultural activities. However, cattle, goats, and sheep are grazed in different sections and fruits and vegetables are produced on all *haciendas*. Near towns the growth of a variety of crops supplies local markets.

Sugar

Grown on most *haciendas* in small patches, sugar yields a low-grade product, *panela*, palatable and nourishing, but full of impurities. The chief sugar fields stretch along the *Canal del Dique* and the Cartagena-Calamar Railway; but only one modern mill, at Sincerin, exists in the entire region. Here, double crushers, vacuum pans, centrifugals, and modern methods produce a sugar of good quality.

In these areas a number of conditions favor sugar cultivation: sandy loam to heavy clay soils of good fertility; gently sloping to rolling surface, providing good drainage and soil aeration; sufficient rainfall for cane culture without irrigation; a sunny dry ripening and harvesting period; and the rather sparse vegetation on land available for cultivation. Cane grows on the same land for years without rotation, fallow or fertilizer; some fields once planted yield 10 to 12 ratoon crops though with decreasing yields of cane and sugar content. Average yields are low, 20 tons per acre, but yields of 40 tons of cane sometimes result from auspicious seasonal conditions.

Several canes are grown but the chief one consists of *Singapore* cane, a rather small cane, giving fair yields

and good sugar content. The fields after planting receive no care, except for chopping out weeds with large hoes or machetes. The culture of the cane depends on *colonos*, or renters, who on allotted cleared land plant the cane with all supplies furnished by the landowner or sugar company and



FIGURE 108.—Bringing in cane on mule back at one of the small sugar mills where the brown *panela* is made. These small mills throughout Colombia restrict sugar culture by modern methods in the Caribbean Sugar District.

receive from \$2.00 to \$3.00 per ton for cane delivered at the *Central*. Most of the juice goes into sugar, but much is manufactured into rum, *aguardiente*, and *chicha*.

Disadvantages for cane culture include several cane diseases and insect pests, a rather long dry season every year and often protracted droughts, the lack of modern cultivation methods, a shortage of labor, the indifference of people who do not care to work, and the small size of the market, owing to competition from other sugar areas of Colombia. The canes have to be cut from December to May, since from May on, the heavy rains prevent work and the high humidity favors rapid deterioration of the cane. An expansion of cane cultivation may replace in this area some of the imported sugar, but

the region lacks the proper transportation facilities to sell in the highland markets in competition with nearer districts (Fig. 108).

Cotton

The chief cotton sections include the low alluvial lands to the east of



FIGURE 109.—Bringing cotton from the farm to the shipping warehouse on the Magdalena near Sitionueva. Bales of cotton may be of almost any size and contain all grades and shades of fiber.

the Magdalena from Piñón to below Sitionueva, and the flat to undulating lands of Atlantico, and Bolívar north of *Canal del Dique* (Fig. 109). Along the Magdalena the brown to black fine sandy loam and clay soils produce good annual cottons as well as the native perennial tree cottons. The other two sections having sandy to heavy clay soils, less precipitation, and a longer dry season specialize in tree cottons. In all sections types are badly mixed. The cotton areas have two well-marked seasons, favoring its culture, a long rainy one from April to October when upwards of 30 to 40 inches of rain falls, and a dry one the remainder of the year when

only even light showers seldom interfere with the bursting cotton bolls and the gathering of the crop.

Grown in small patches, by mulattoes, the cotton receives little care, except in some sections along the Magdalena, where several fields appeared well tilled. The tree cottons, lasting from three to five years, yield one crop each year. Branches of the shrubs often attain a length of 20 feet. These are broken down before picking time, a small piece of bark left holding the branch to the tree; the loss of sap causes the green bolls to open; the breaking of the branches serves as a pruning. Soft unripe fiber is then picked with ripe and over-ripe fibers; all kinds may be dirty from having been on the ground. By careless picking as much as one-fourth of the crop may be left in the field. Tree cottons save labor and yield a long, rather fine fiber, but they encourage insect pests by providing hiding places for them. Though possessing auspicious physical conditions for cotton culture, little development may be expected in this district in the near future. Both annual and perennial types yield good fibers, of 1 to 1¼ inches, but they are mixed with types of ¾-inch fibers, making the entire pick of less value than if all the fibers were short and of uniform length. The long fibers are too good for spinning the low counts of 12 to 20, the average of all the cotton spindles of the country. Labor is scarce, expensive and indifferent. No attempt, as yet, is being made to combat pests, or to select uniform seed, and grade the cotton. These mixed cottons cannot enter foreign regions, and internally they compete with cotton from regions having as good physical conditions and a better labor supply.

MAGDALENA GENERAL FARMING AND GRAZING DISTRICTS

In many respects these areas resemble the grazing lands of the savannas, but from the latter only cattle on foot or hides move to distant marts whereas from these sections, especially along the Magdalena, in addition to cattle and hides, cheese, vegetables, fruits, swine, and chickens by dugout or steamboat find a place in the markets of all riverside towns. Formerly supporting a me-

a single or a group of pole-palm thatched huts of the docile lazy mulatto or the headquarters and stake corrals of a vast *estancia*.

On these river bank farms and cattle lands the mulattoes live with a minimum of labor and mental effort. Fertile alluvial soils, with high temperatures, copious rain, and much soil moisture yield abundantly without tillage; fresh food, available for much of the year for the picking, includes corn, beans, cassava, mangoes,



FIGURE 110.—A mulatto village in the farming region along the Lower Magdalena. Back of the town are patches of bananas and other produce, gathered and marketed in down river points.

dium to heavy forest growth much of these low and often flooded alluvial lands of fine sandy loam and clay black to brown soils, now grow a variety of crops, and *Para* and *Guinea* grasses, luscious during the long rainy season, and not so parched as those on the higher savannas in the dry season. Pastures occupy most of the land because a market does not exist for large quantities of fruits and vegetables; yet for miles fine looking fields of corn, plantains, and bananas line the river banks, the verdure being interrupted only now and then by an opening containing

bananas, plantains, coconuts, and others. Patches of corn in all stages of growth may be seen side by side; plantain and banana shoots used for propagation simply stuck in the ground need no further attention; when the fruit ripens the plant is cut down; from the root suckers come forth and bear again and so on for years. Plantains are eaten green in soups, half or fully ripe boiled, fried, or roasted. In sections pork, chicken, and beef supplement the diet, though many people seldom eat meat. As in the savannas the cattle are low-grade stock and receive no

attention, yet in sections near a market cheese may be made and sold. Every river steamboat plying the muddy waters gets its meat from a cattle pen along the bank, whenever the fresh supply is exhausted. The animals, pulled onto the boat with a rope around the horns, are slaughtered as needed.

With life so easy in this district and leisure the greatest luxury of the self-satisfied mulatto, only the more energetic folk pile their produce—fruits, vegetables, pigs, chickens, and cheese—into a dugout and glide down the river to a town, there to dispose of only a portion of what they have as the market is congested, and then to laboriously pole the heavy dugout up the swift current along the bank in the scorching sun and enervating humidity. Though prolific nature produces much, there exists little chance for a significant development in the face of restricted markets, and sparse, and easily satisfied mulatto population (Fig. 110).

FOREST DISTRICTS

As in the Pacific forests, the forest areas of northern Colombia have a large variety of trees and a rather dense stand. They enhance the broad strip of land along the northern margin of the Central Andes, across the San Jorge and Cauca basins, far up the Magdalena to La Dorado, the low plains and hills east of the Cesar Valley, and a broad area south of the Sierra Nevada Mountains. The portion of the lower Magdalena basin just west of the banana region consists chiefly of broad mud flats and winding channels bordered by dense mangrove forests, and hardwoods on slightly higher ground. Inhabited mainly by mulattoes along the rivers and by backward forest

Indians in the remote sections these areas possess little agriculture. Here and there are small open clearings, where patches of corn, cassava, and a few fruit trees surround the lowly huts of the inhabitants.

The whole area supports a gathering industry of forest products. But, the forests vary greatly in composition and economic value. Along the rivers stretch swampy forests of palms and other types of rapid growths, subject to frequent inundation. The woods, often fairly light in color and weight, have been cut. In the swamps west of the banana region the chief activity of the inhabitants consists of cutting wood for steamers and nearby towns. Of special value for local construction purposes in these forest solitudes is the *cana brava* (*Gynerium* sp.), that grows in luxuriance to 15 or 20 feet high and with stems 1 to 3 inches in diameter. On the slightly higher lands and slopes grow the trees yielding the products that are gathered by the forest folk. They include the whole list of those taken in the forests of the Pacific margin: tagua, toquilla, coconut, wax, and other palms; *Castilla elastica* and *Sapium tolimensis*, two rubber trees; the balata tree (*Nispero*); the *lirio*, yielding a substitute for chicle; the two balsams; and *ceiba pentandra*, the monarch of the forest, which supplies kapok. The gathering industry, persisting under the most primitive conditions, will continue in a desultory fashion.

THE SIERRA NEVADA DE SANTA MARTA REGION

Occupying a triangular space of nearly 6,000 square miles between the Magdalena lowland on the west and the Cesar and Rancheria valleys on the southeast, the Sierra Nevada

de Santa Marta, which rises to snow-capped peaks of 19,000 feet in places, presents contrasted conditions of relief, soil, climate, and vegetation, and consequent agricultural adjustments. Though dominated by the commercial production of bananas and coffee, the region yields many subsistence products in the banana and coffee sections as well as in other portions. The crops range from the truly tropical on the slopes bordering the adjacent lowlands through the subtropical of the upper portion of the

On the broad gently sloping piedmont plain, that spreads out for ten miles or more from the base of the mountains, flow several depositing streams, that have built up plains of fine sandy loam soils of considerable depth, ideal for bananas when well-drained. The important streams, including from north to south Rio Frio, Sevilla, Tucurinca, Aracataca, and Fundación, provide at no great expense the waters for irrigating the fertile soils; from most any point along their courses water may be



FIGURE 111.—Cattle feeding on *Pará* pasture planted on the higher interstream areas between the banana plantations in the Aracataca District. (Courtesy of the United Fruit Company.)

coffee zone to the temperate below the cold *paramo*.

BANANA REGION

From the salt flats, a few miles southeast of Cienaga, the banana region extends south for about 40 miles on the piedmont plain at the base of the mountains and along the Santa Marta Railway. With a deep, well-protected harbor, encircled by a curved shore and high islands, at Santa Marta only a short distance away, the banana region has many auspicious physical conditions for banana culture.

diverted to the farms and drained off into the great swamp—Cienaga Grande to the west by master ditches cut by hand in the fine alluvium. On the swampy or higher interstream areas, some of which constitute potential banana land, grow tropical forests or excellent *Para* and *Guinea* grasses planted for the draft cattle of the region (Fig. 111). The streams coming down from the high Sierra Nevada carry a load of fine soil materials and with each irrigation adds some to the fields. So productive are the soils that little fertilizer is applied even to fields which have

grown excellent bananas for 30 to 40 years. Soils vary from pure sands to fine clays, but those along the streams generally consist of fine sandy clay loams; the best soils are sandy clay loams with 15 to 35 per cent clay. Soils with more than 40 per cent are too heavy, have poor drainage and favor diseases and rot. In all soils the water table must not be within three feet of the surface.

On these sandy loam soils, a dense tropical hardwood forest constitutes an obstacle to the establishment of a plantation. To clear, burn, plant, and clean until the first crop, one year after planting, it costs about \$50 per acre (Fig. 112). A hot region, the temperatures of the banana sections vary little from season or from month to month. Usually they range from around 72° F. at night to 89° F. or above in the hottest part of the day. All the mornings and most of the late afternoons are clear and hot, giving a large percentage of sunshine, a condition required for the best development of the banana.

Precipitation in the banana section increases from about 35 inches near Rio Frio to 65 inches in the southern portion. Most of the rain falls in heavy convectional showers during the early afternoon at two periods: April to June inclusive, and September to November; some years the rains continue through July and August. During the rainy months no irrigation is necessary, but during the dry season the plantations are irrigated about every 20 days. For this there exists a good supply of water, the precipitation at intermediate elevations in the Sierra Nevada being about 100 inches and the rainy season longer, and the higher parts of the mountains possessing large permanent snow fields.



FIGURE 112.—In the Fundacion District of the Santa Marta Banana Region. Opening up a draining ditch for irrigation and drainage. Before the land is made ready for the ditch the heavy tropical hardwood forest must be cleared.

While the rains usually come without much wind, local strong winds wreak havoc on some farms. Though some years are free of winds, most seasons have strong winds in April and May, and September and October; as many as 1 to 1¼ million bunches going down each year in the face of the winds. This equals about one-ninth of the total production; but since the worst winds come during the slack market season in the United States, the injury does not prove disastrous. The wind trouble is leading to some interesting results in the speeding up of fruiting in some sections by close planting and heavier irrigation.

Possessing much sunshine, high temperatures, and good drainage, the banana fields are peculiarly free from diseases and insect pests. The region does not have the Panama disease, a disease that has all but wiped out the industry in other areas,

nor the banana root borer. But, it has a scale which causes some loss, since it produces a black spot on the skin, making the fruit unmarketable, though the inside remains in a perfect condition. Fortunately, the chief damage of the scale comes during the slack market season.

Physically one of the finest banana areas in the world, the region possesses also an admirable economic organization for the efficient growth and shipment of the fruit. Here, private growers who sell to the fruit

in the several districts, require some 10,000 laborers, who make, by piece work, from \$1 to \$1.50 per day, 160 foreigners and 5,000 head of cattle for draft, beef, and milk. All the laborers consist of Negroes and Mestizoes; they are affected by the tropical climate of the banana area, subject to malaria, and are anemic to a considerable extent.

Once a banana plantation is established, which includes diking of the main river, clearing and burning of the forest, planting, cleaning to the



FIGURE 113.—Banana plants, two months old, among tree stumps on planted land. In the distance are the tall trees of the tropical forest.

company have 20,000 acres of land in bearing. The United Fruit Company holds a lease on nearly 100,000 acres of land of which 30,000 acres are in bananas, and nearly 10,000 in pastures and other improved land. The company extends the plantations at a rate of 1,500 acres per year with the gradual increase in consumption, and with the abandonment of small areas where salt water has come in the old Rio Frio district, where the soil is too heavy, or where the water table is too high. The company's holdings, divided into forty farms

first crop and digging the drainage and irrigation ditches, the fields require little attention (Fig. 113). About every two months the weeds are cut with a surface shovel and piled between the bananas. The soil needs no cultivation as it is so loose and friable. After a plant bears a bunch, it is cut and piled with the weeds to rot. New sprouts grow and yield, one after another for five or six years, when the old and rotten root system is uprooted. A new planting between the old rows, where weeds and banana stalks have de-



FIGURE 114.—Carrying bananas on cattle carts to the loading station from which the bananas are loaded onto railway trains that carry them rapidly to Santa Marta. Railway spurs extend out into all of the banana farms.

cayed, starts the cycle all over for six more years.

So well organized and coordinated is the cutting, packing out, and shipping by rail to Santa Marta that 160,000 bunches from company and private farms can be put onto a ship in 15 hours; a telephone call from the manager in Santa Marta starts in motion the hands and machinery that deliver this huge quantity of fruit in a few hours, with only a slight shortage or a small overcut (Fig. 114).

A result of favorable physical conditions, marked increase in consumption in middle latitudes, a decreased production in other regions, efficient activities of the fruit company, and freedom from export duty and taxation, the shipments of bananas from the Santa Marta region increased from 70,000,000 pounds in 1908 to more than 500,000,000 pounds in 1926; in the past two years winds have reduced the yields materially. The industry, so far as available land is concerned, is capable of marked expansion.

In contrast to the excellent methods of banana production, subsistence crops, including corn, cassava, and

beans, show primitive conditions. Planted in small scattered patches cleared of brush and unplowed, these crops receive no attention except for chopping out the larger weeds with the machete. The only implements used in the region include the machete, shovels, hoes, and axes. But, on the cattle estates of the fruit company, better methods prevail. Much has been done to provide good pastures of *Para* and *Guinea* grass, to regulate breeding, to improve the stock, and to restrict the ravages of insects and diseases.

COFFEE PLANTATIONS

In the deep V-shaped valleys on the north and western slopes of the

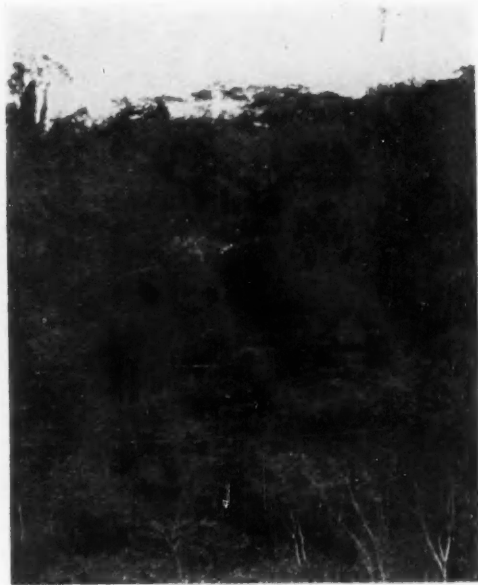


FIGURE 115.—On the Cincinnati Coffee Estate in the Sierra Nevada de Santa Marta. The tall white-trunked trees are the Guamo shade trees. Beneath are the close-growing coffee bushes.

Sierra Nevada de Santa Marta, from 3,000 to 6,000 feet elevation, lie a number of fine coffee plantations and many small holdings. Together they have nearly 6,500,000 bearing trees,

two-thirds of which are young trees entering the prime of productivity; but, this number represents less than 2 per cent of the bearing trees of Colombia. Here, on the steep slopes the guamo (*Inca vera*, and *I. sapida*), a legume with a tall, slender, white trunk and bushy crown, partially

soils seem to resist erosion remarkably even on steep slopes and under heavy precipitation; (3) almost ideal temperatures ranging from 60° to 80° F.; (4) annual rainfall amounts to 60 to 70 inches, most of which comes as noonday or afternoon convectional showers from April to November



FIGURE 116.—A coffee tree five to six years old and twelve feet tall. The top is bending over to the ground under the heavy growth of coffee berries almost ready to harvest. Expensive labor in this region prohibits the careful pruning of the coffee trees that is done in the central range of the Andes south of Medellín.

shades the closely growing coffee bushes beneath (Fig. 115).

One of the best coffee regions of Colombia, the Sierra Nevada possesses several advantages: (1) steep slopes providing good drainage in protected valleys having little or no strong wind; (2) deep fertile soils; the top layer consists of dark brown clay with much humus; the sub-soil for several feet in depth is heavy red clay high in iron and potash. These

inclusive; no heavy downpours in March and April interfere with proper flowering; (5) much sunshine even during the rainy season promotes good growth; (6) a long dry ripening and harvesting period facilitate gathering and preparation of a good quality coffee; (7) the region is peculiarly free from diseases and insect pests; (8) transportation to the port of Santa Marta for only one cent per pound represents an insig-

nificant item compared to the transport of coffee from Antioquia to the Caribbean.

Though the region possesses admirable physical conditions in a good location near the sea, it suffers from a shortage of labor, resulting from sparse population in the hills, good wages paid by the United Fruit Company, favorable living conditions provided by that organization, and the ease of life on the lower slopes where Indians may live without much work. Most of the labor on the coffee plantations consists of mestizoes and Indians, who make by piece work from \$1.00 to \$1.25 per day, well above the average of 50¢ to \$1.20 per day for all Colombia. Laborers come in from across the Magdalena and even from the West Indies Islands during the chief harvest period from the first of November to the first of January; a second harvest comes in March and April.

Plantations once established require a minimum of work except at harvest time; in this district, owing to the cost of labor, coffee trees are not pruned back; they grow to 12 or 15 feet in height, often breaking over under the weight of a good crop (Fig. 116). But, the dead wood is cut out every year or two. Fields, weeded once with a hoe and twice with a machete each year, get no other cultivation. The close shade of the trees retards the growth of weeds and grasses.

Favored by physical conditions, a marked expansion of coffee culture in this region awaits the opening of good mountain trails and an increase in the labor supply.

On the coffee plantations, as subsistence crops, corn, cassava, potatoes, bananas, grapefruits, oranges, and other fruits are produced; as in



FIGURE 117.—The first crop of corn on land recently cleared from a heavy growth of forest in preparation for the planting of coffee trees. On the steep slopes the soil wash is fairly rapid until the roots of the coffee and shade trees are permanently established.

the banana region, they receive little attention. Corn serves as the first crop on cleared and burned land, being prepared for coffee (Fig. 117). In this zone many stock of low grade are kept for meat, milk, and draft. The pastures consist chiefly of two planted grasses, *Yaragua* and *Maquia*. *Maquia*, more of a turf grass than *Guinea* grass, keeps weeds from growing and serves well as a fattening grass; as it does not dry up like other grasses, it favors a good yield of milk.

Outside the coffee and banana zones subsistence agriculture prevails in patches throughout the Sierra Nevada de Santa Marta. From tropical climes to Paramo, backward Indians gather a variety of crops upon which they bestow little

or no care and graze a few animals per family on forest clearings kept from tree invasion by periodical burning. Living in low adobe huts of one or two rooms covered with thatch they produce the bare necessities of life and no more. Though the Sierra Nevada de Santa Marta supports a verdant tropical forest in the lower reaches, and temperate species in the higher portions, owing to a sparse population of backward Indians, and poor mountain trails, there hardly exists a forest gathering industry as in other portions of northern Colombia.

THE GOAJIRA PENINSULA

To the east of the Sierra Nevada de Santa Marta stretches the Goajira Peninsula, which embraces a territory of more than 5,000 square miles, almost as large as its neighbor to the west. Chiefly a low-lying region, it rises in broad sandy steps from the Caribbean coast. Sparsely inhabited by Indians, living in a backward state and often in semi-nomadic tribes, who gather sustenance from xerophytic forest of cacti and thorn bush and a few goats, the region produces little in the way of farm or pastoral products. Some fertile valleys exist and water is available, but irrigation is practically non-existent.

Always hot, though tempered by the refreshing Caribbean breezes, the peninsula receives less than 35 inches of rain per year. For half the year, from December to June, a parched desert land, it receives less than 4 inches of its annual quota. Then, man must turn to the sea or wander with his animals to find sustenance, and vegetation adopts all xerophytic characteristics at its command to live over the period of dessicating drought. In the center of the pen-

insula some considerable areas of savanna lands with a short grass (*Arestida*) may be used in the short rainy season but must be abandoned at other times; in the southwestern part of the peninsula some large pastures of *Guinea* grass exist, but they suffer in the dry months.

The chief wealth of the region rests in its goat herds, which supply meat and milk for the inhabitants and skins for export, in its xerophytic forests, and in its horses from the pastures of the Rio Hacha Valley, the best portion of the region. The forest materials of note include the pods of divi-divi (*Caesalpinia coriaria*), the pods of algarroba (*Prosopis canipetris* and other *sp.*), and the fibers of the leaves of *Furcraea macrophylla*, a species covering large areas in the Rio Hacha area. The divi-divi, with a broad branching crown, sparsely scattered over all the arid sandy wastes, produces many pods that yield 40 to 50 per cent tannin. The pods of the algarroba, also rich in tannin, yield a high-grade product for tanning fine grades of leather. The seeds of these trees supply a needed article of diet in this arid region. Though a few fertile valleys exist in the southwestern portion, the region as a whole can advance little in agricultural activities. Its inhabitants must strive hard to eke out a living on the sandy wastes from goat herd and from cacti, thorn-bearing bushes, and other xerophytic forms.

SIERRA DE PERIJÁ

East of the savannas and forests of the Cesar and Hacha valleys rises the Sierra de Perijá, a rugged mountain region, occupying more than 6,000 square miles. The western range continuing north from the Sierra de Ocaña contains peaks from 9,000 to 10,000

feet high; eastward several ridges decrease in elevation to near 2,000 feet in the easternmost one that drops off rapidly to the Maracaibo lowland near Machiques. Throughout much of its extent it consists of a wild country, uninhabited over vast stretches and possessing little game, or inhabited by small uncivilized Indian tribes at war with each other a great deal of the time. Not a single well-travelled or known trail crosses the entire region.

Though well within the tropics the moist heights have variable temperatures; the steep humid slopes with a heavy deep terrane support a dense tropical rain forest, while in the thin soil areas on the crests of the ridges, shrubs, giant ferns, and wiry grasses replace the forests.

Where Indians dwell in pole-thatched huts, primitive forest agriculture is practiced in small clearings or burned areas. The Indians grow, without any tillage, yams, bananas, plantains, corn, and cassava; they keep a few chicken and swine, but other animals are not present. Inhabited by forest Indians, who desire to be left alone and remote, little development may be expected in this little-known area.

MARACAIBO-SEGOVIA REGION— TROPICAL CROPS AND GRAZING

Like the districts of Northern Colombia, the Maracaibo-Segovia Region presents a variety of physical conditions, population groups, and consequent agricultural activities. Though lacking uniformity of conditions within, the region stands out in contrast to the little-known forested Sierra de Parijá on the west and to the Andean Crops and Grazing Regions on the south. In many parts tropical crops, especially sugar cane,

corn, cacao, and cassava, without irrigation in the Maracaibo basin, or with irrigation in Segovia, dot the region. Likewise small savannas supplement the tilled portions. But, most of the region supports a forest vegetation; a tropical rain forest around the southern portion of Lake Maracaibo and a xerophytic forest bordering the north part of the lake and over the Segovia Highlands and Paraguana. Sharp contrasts in environment, peoples, and agricultural economy delimit two major sub-regions: the Maracaibo Lowland and the Segovia-Paraguana region (Fig. 118).

THE MARACAIBO LOWLAND

Lying in general only a few feet above the level of the lake, the surface of the lowland presents some variety significant in relation to crops, pasture, and forests. Around the southern end of the lake, reaching a width of nearly 90 miles southwest from the mouth of the Catatumbo, stretches a flat plain crossed by numerous meandering streams and dotted with many large swamps; here, vast areas only slightly above the level of the water in the streams are flooded periodically. To the north along low sandy plains possessing few river valleys and now and then rising a few feet in sandstone hummocks border the narrows of the lake and extend inland for 35 to 45 miles. On the border of these flat lands a rolling hilly or ridge belt, of varying width, marking the outcrop of a bed of rock or the erosion by running water, rises gradually to the base of the several adjacent highland areas that stand out prominently as viewed from the lowlands. Almost entirely of recent marine or alluvial sediments the soil materials

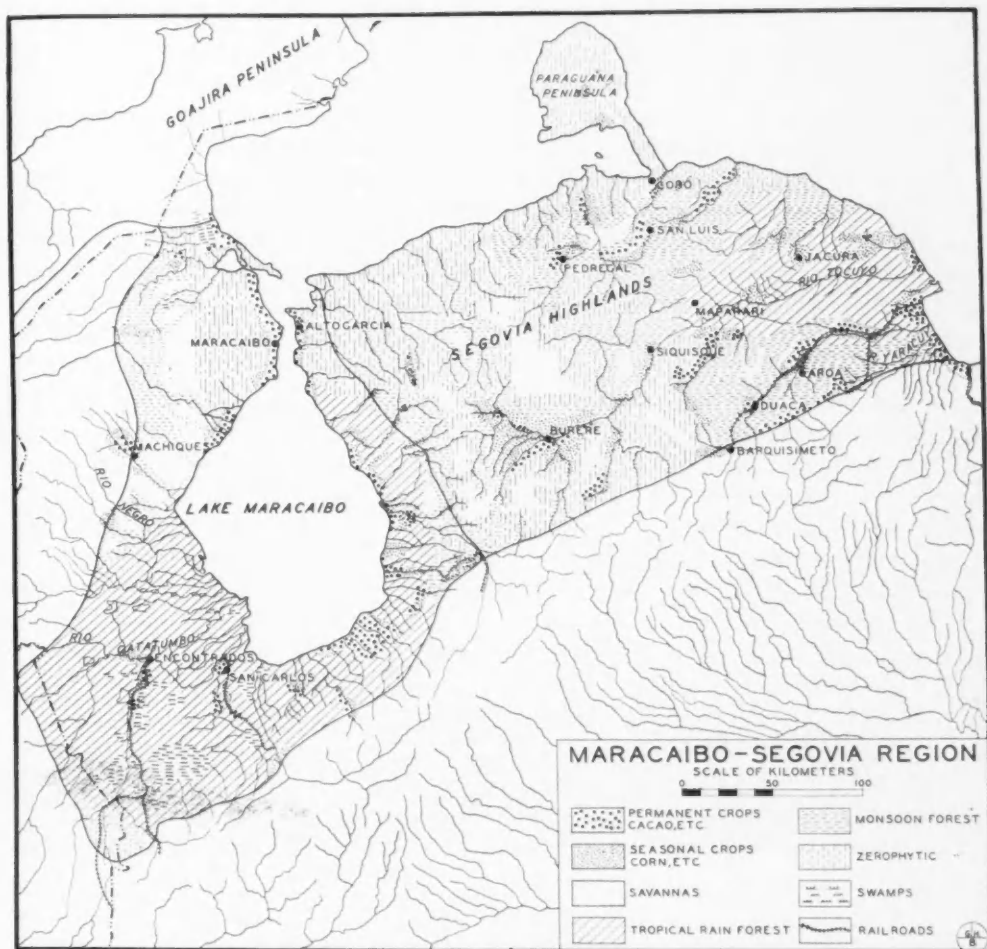


FIGURE 118.—Most of the area of the Maracaibo-Segovia Region consists of tropical rain forest and savanna in the lowlands and of xerophytic forests or sandy wastes in the Segovia Region. In both the areas, crop lands occupy very small areas.

vary from the coarse sands and clays in the hilly belt through fine sands along the streams, to silts and heavy clays in the deltaic deposits of the numerous streams. Where sufficient water is available, if drained, they produce abundantly. Elsewhere, they present sandy wastes, savanna lands, or xerophytic woods.

One of the hottest regions in all South America, the Maracaibo lowland has high temperatures most of the time. In general, temperatures range between 68° F. and 95° F.;

different stations have average annual temperatures of 73° F. to 80° F. These temperatures, combined with high humidity, in many parts, promote vegetative growth but produce enervating conditions, especially during the middle of the day.

Not so uniform as temperatures, precipitation varies from almost none on the low sandy peninsula north of Maracaibo to 21 inches in Maracaibo City and to near 50 inches or more in the southern portion of the basin. In general, two rainy seasons, May-

June–July, and September–October–November, separate two seasons of almost no rains. For the region as a whole, the season of greatest rain extends from early September to early December; during the quarter—December to February—most of the region gets less than 2 inches of precipitation; Maracaibo receives one-half inch during this quarter. The amount and seasonal régime of rainfall affect vitally the type and distribution of vegetation as well as agricultural activities.

Bordering the narrows of the lake in the north for 25 to 30 miles, the dry, sandy, low plains support a sparse xerophytic vegetation of cacti, *divi-divi*, *algarroba*, and other gnarled

presents a different aspect. It consists dominantly of a tropical rain forest with a great variety of species in a fairly dense stand. The forest solitudes and their Indian inhabitants release only patches for cultivation or broader areas here and there along the rivers and the few railway lines for pasture lands of *Para* and *Guinea* grasses or on strips of especially heavy clay soils for native savannas invaded by only a few palms (Fig. 119).

CROP PRODUCTION

Crop lands, though producing a considerable variety, occupy mere spots in the vast Maracaibo lowland. Many conditions restrict agricultural activities: aridity and sandy soils in



FIGURE 119.—Rather extensive pasture lands of both *Para* and *Guinea* grasses cover an area adjacent to the major river highways and railways in the southern part of the Maracaibo lowland.

shrubs and trees. Of grass there is little, goats finding it difficult to pick a precarious living from the drought-resistant growths; only along marshes do wiry grasses provide forage for cattle. Back of these reaches stretch narrow strips of dry woodlands having the giant *ceiba*, cedar trees, and several palms, but very little underbrush and meagre forage except along marshes. Further inland to the foot of the adjacent highlands extend the broad savannas, broken only by finger-like bands of trees on the moist soils of the river valleys or clumps of palms and other trees around the many marsh areas. The southern portion of the Maracaibo lowland

the north; copious rains and imperfectly drained soils in the south; small and inefficient labor supply; hostile tribes, especially the Motilones dominating the vast area between the Rio Negro and the Catatumbo; many insect pests and diseases; inadequate transportation facilities and the lack of a big market for the quality of articles produced. Crop lands consist of two types: the large plantations of cacao, sugar, coconuts (in the northern portion), and subsistence corn, cassava, and beans on the vast estates of the large landholder, and the small patch in a forest clearing of the Indian or the mulatto, who desire to produce only enough corn, cas-

sava, bananas, breadfruit, pigs, and chickens to satisfy their gluttonous appetites.

Cacao, almost absent from the northern portion for want of sufficient precipitation and humidity, finds in the southern reaches of the lowland auspicious conditions for rather extensive culture; deep sandy loam to clay soils of the natural levees and some interstream areas, abundant moisture and sufficient humidity of the long rainy season followed by a short, sunny, almost rainless season, constantly high temperatures, and an absence of any strong winds to shake the heavy pods from the trunk or the large branches. Offsetting some of their more favorable conditions is the rapid growth of fungus on the overshadowed trees (all the plantations examined by the writer have from 10 to 25 per cent too much shade; even where new trees have been replaced on old plantations few, if any, of the tall branching shade trees had been removed); widespread leaf blight and black pod rot; imperfect drainage in many groves; small labor supply, indifferent to the better methods of culture; absentee plantation owners, for the most part; and only fair methods of preparation combined with the tendency of the beans to ferment in the humid climate and under the slow methods of transport available. Most of the cacao plantations border the more navigable rivers, as the Catatumbo, Zulía, Escalante, and the three railway lines that cross the region. Established in the tropical forest, by clearing out the trees except those desired for shade, and planted about 80 to 100 plants to the acre, the trees begin to yield in about seven years and then bear for 30 to 40 years. Most of the cacao grown consists of

medium-grade "criollo" type, nearly all the output being exported.

Sugar, grown on several large estates along the eastern and southern shores of the lake and treated in fairly large modern Centrals, enters the export trade to the extent of several million pounds and is produced in small areas for the manufacture of brown coarse *papelón* or *panela*, the chief sugar consumed in Venezuela. In the districts of commercial production, sandy loam to dry soils of good humus content and fertility, a long rainy season followed by sunny dry weather favor the production of 40 to 50 tons of cane per acre, but the sugar content of 7 to 9 per cent is low. The fields, once established, yield several ratoon crops, with only surface cultivation, two or three times while the young cane gets a good start. Low-lying lands require expensive drainage, but irrigation is not necessary. Labor is scarce; all the districts breed malaria mosquitoes by the millions. Under favorable physical conditions the sugar industry of the lowland might expand materially with a better labor supply and a larger market; but it seems that Maracaibo sugar cannot compete with that from Cuba, Hawaii, and other regions and a large domestic market awaits the replacement by refined sugar of *panela* in the upper class and mestizo population, a change in diet that may take place very slowly.

Cotton, produced in a small way in the sections adjacent to the lake south of Maracaibo and Altagarcía constitutes a minor crop. No large plantations exist; labor is expensive and inefficient. Though good cotton soils are found locally, small and uncertain precipitation deters expansion. Farther south too much rain

and high humidity retards ripening and badly discolours the fibers. Mostly short staple upland American cotton is grown, being reseeded every two years, but facing competition from the chief cotton-producing and manufacturing sections of the country, this district can witness little advance.

Coconuts in many large and small plantations along the shores of the narrows of the lake supply a commercial crop of some significance for coconut oil and copra. Under auspicious conditions the groves give good returns with little or no care for many years.

On the large cacao, sugar, and other estates, several crops, including corn, bananas, cassava, breadfruit, mangoes, and others are grown for local consumption as well as on the small cleared patches of the forest Indians and on some of the cattle *estancias*. As in all areas of primitive forest agriculture the crops, grown often among burned or girdled trees or between the rows of other crops, may be cleared of weeds once or twice during the season. This type of tillage can never mean much to the region as a whole, beyond supplying the simple wants of these backward folk (Fig. 120).

GRAZING

The grazing areas of the Maracaibo lowland embrace three types in different sections of the region. In the northern portion, xerophytic forests with a very meagre growth of grasses provide poor forage for many goats, which pick a precarious living from the sandy wastes and provide the barest of necessities for the mestizo or mulatto owner dwelling in a mud hut and subsisting chiefly on the products derived from the herds.

So dry is the area that few crops are grown; water for the people and the herds comes chiefly from holes dug in the beds of dry streams. Ranging within the confines of brush fences during the day, the goats are enclosed at night in a stake or brush corral near the house of the owner. Agriculturally, naught else but an



FIGURE 120.—Bamboo pole-thatched huts in the tropical rain forest in the southern part of the Maracaibo Basin. To the left of the huts are patches of corn and cassava, the principal crops of the forest lowland Indians.

arid goat grazing land can these sandy areas become.

In the north, bordering the goat grazing districts, are the broad savannas broken at short intervals by strips and clumps of mesophytic arborescent forms. Here, vast cattle estates embrace most of the land. Under the management of a mestizo major-domo the *estancias* graze cattle, goats, horses, and mules in considerable numbers. They fare well on the native coarse grasses during the rainy season, but find scant forage at other times and also thirst for water. Of poor quality, few animals reach the lake markets on foot, but they supply quantities of dried beef and white cheese for adjacent lake marts, and hides for overseas. Though these savannas will produce a variety of crops and fruits, the inhabitants

subsist chiefly on a milk and meat diet; on many of the *estancias* a traveller would find it difficult, if not impossible, to procure fresh vegetables or fruit. Isolated, peopled by indolent Indians or mestizoes, and competing with better pastures elsewhere, these savanna areas promise little.

The third type of range land, in the southern part of the Maracaibo lowland, borders the river highways, the railways, and the marshy, heavy clay belts. For miles tall *Para* grass pastures break the continuity of the tropical forests; they provide good grazing for low-grade cattle for much of the year; with river and rail transport the *estancias* of this district send thousands of animals to the lake markets each year. Though the ranges are fenced, little attention is paid to breeding or grazing; the whole area lacks one good dipping tank, but Texas fever is endemic; other diseases and pests take heavy toll. Many cattle put on good flesh during each season, but the market, except for hides, does not extend beyond the lake towns and oil fields and the Dutch West Indies.

FOREST PRODUCTS

The mesophytic and xerophytic forests, which cover most of the lowland, have given rise to two types of industries. In the former, along the navigable rivers and railways of the southern part of the area mahogany, rosewood, ebony, boswood, and bastard *lignum-vitae*, cut and hewn into square timbers, are transported by water to Maracaibo, the chief lumber center of Venezuela. Lumbering consists of a primitive type, often carried on secondary to the establishment of a sugar, cacao, or cattle estate. As the more accessible timbers are

cut, the industry decreases in significance. The arid forests supply the pods of *divi-divi* and *algarroba* in variable amounts for tanning extract; in one or two places plantations of *divi-divi* have been established. But, the forest industries, like crop production and grazing, promise little expansion under present conditions.



FIGURE 121.—Typical vegetation of the Peninsula of Paraguana and the mainland to the south of the peninsula.

THE SEGOVIA HIGHLANDS AND THE PARAGUANA PENINSULA

The Segovia Highlands and the Paraguana Peninsula produce a variety of crops, and graze many animals, but they show a different type of land use and lack the possibilities of the Maracaibo lowland to the west. Inhabited chiefly by Indian and Mestizoes they have a population density over most of the area of less than 10 persons to the square mile. Except the railway from Barquisimeto down the Yaracuy valley, they have no modern means of communication. Regions of irrigated crops and dry pastures, they produce much of what they consume and little else.

In relief the region presents strik-

ing contrasts to the flat, imperfectly drained Maracaibo lowland. Sandy beaches, salt marshes, and lagoons border the sea. Fairly continuous for long distances the coastal flats are broken here and there by mountain spurs that dip into the waters of the Caribbean. Chiefly narrow strips, they extend inland in places for 60 miles or more. A sandy rolling plain ties Paraguana to the mainland. Most of the area, rising from 1,500 to 3,500 feet above the sea, consists primarily of a rolling to rough tableland. In the north part three distinct ranges rise from the plateau surface, the northernmost one and the longest extending for more than 100 miles parallel to the Gulf of Venezuela. Farther south the deep Tocuyo and its principal tributaries drain most of the region; nearly all the other rivers rise on the outer margin of the highland and descend rapidly in deep valleys to the Caribbean or Lake Maracaibo. The soils of the area, coarse, sandy, rich in mineral constituents in general, but low in humus, produce abundantly only where the land is irrigated, for aridity dominates the region.

In general, high temperatures prevail, but the diurnal and seasonal range is greater than in the Maracaibo lowland, owing to both aridity and higher elevation. The glaring sunshine on light sandy terrain is trying to both man and beast, but it stimulates rapid growth when the rains come. The region as a whole receives less than 20 inches of precipitation, insufficient most everywhere for crops without irrigation. But, some northeasterly slopes receive much more, enough for patches of coffee and cacao in sheltered valleys around San Luis, Pedregal, Jacura, Aroa, Maparari, and Duaca.

Except for the short rainy season that lasts from the first of September to the first of December, it constitutes a parched land, a region of dried pastures, wilting crops, withering vegetation and thirsty, panting animals. For the quarter—December



FIGURE 122.—The adobe pole hut roofed with mud in the semi-arid grazing country south of Carora. In this country farming and grazing cannot extend beyond the limit set by desert aridity. (Courtesy of Ernest G. Holt.)

to February—the region receives less than 2 inches of rain; some of the steep slopes facing the winds may get more than 2 inches at this season, but deep valleys and table lands may go for six months or longer without a drop of rain.

Consequent upon precipitation and exposure the vegetation varies from the *cocales* and mangroves of the coastal forest through the adjacent strips of extremely arid cacti zones to the sparse rain forests, especially on the northeast slopes, arid grassy stretches on the favored slopes higher up and to the all but barren sandy tablelands. Most everywhere the giant cactus, sentinal-like, juts from the stony terrain, and casts a spell upon the repellent land (Fig. 121).

AGRICULTURE

Dominated by rough surface, sandy, stony soils, low in humus and aridity

most of the time, the region possesses only a few thousand acres of crop lands. They include two types, permanently cultivated and periodically tilled. The first embraces mere finger-like strips along the streams or broader patches on alluvial fans where water irrigates the thirsty soil every year; the second class includes irrigated areas abandoned when the supply of water becomes low, or districts that can be dry-farmed in seasons of unusually heavy precipitation. Periodically tilled lands embrace a greater areal extent than lands irrigated every year. The great handicaps to crop production comprise the small amount of water available for irrigation and the variability of the precipitation.

The crops grown include a variety, the chief ones being corn, cassava, sugar, beans, tobacco, and in a few places coffee, cacao, and coconuts. After planting the crops receive practically no care, except for watering now and then. No modern implements exist in the entire region. While a few people leave the region for want of food in years of extreme drought, this area does not constitute a famine zone like Ceará, Brazil; in fact, in most years the inhabitants supply their wants and have a small surplus, especially on the Caribbean slopes, for export to the Dutch West Indies.

GRAZING

For the area as a whole grazing is confined to the voracious goat that finds difficulty in picking sufficient forage from the xerophytic vegetation. During each rainy season a sparse growth of grasses springs up rapidly to be nipped as quickly, or escaping the teeth of a hungry animal, to die down as promptly with

the cessation of rains. Grazed in small herds, chiefly by sedentary folk, goats provide the two principal products, goat skins and manure, of the north part of this region, including the very sparsely inhabited Paraguana Peninsula. In a few areas natural pastures provide forage for cattle; these include the high valleys and slopes around Carora-Burere, Siquisique, and some of the high valleys north of Barquisimeto. With the rainy season, cattle, as well as goats, move onto the more desert areas, and with the oncoming dry season they retreat to the more moist pastures and even the irrigated pastures and stubble fields. Thus, the grazing industry cannot expand beyond the limits set by desert aridity.

THE FUTURE

These two regions, the Maracaibo lowland and the Segovia-Paraguana highland, greatly differing agriculturally except in the crops grown, present striking contrasts in possibilities. In the latter the inhabitants, constantly pushing towards the limit of subsistence in arid environment, can advance but little (Fig. 122). In the former, the possibilities of the fertile moist plains of the south have scarcely been touched owing to enervating heat and humidity, troublesome insect pests, or ravaging diseases, hostile Indian tribes tenaciously clinging to their lands, the lack of modern methods, and a small, almost stagnant, market. However, with oil developments, the curtain begins to lift, even agriculturally, over the Maracaibo basin; but the wheels of progress can roll only slowly in the face of all the preceding handicaps and with competition in all its products with those of the more densely settled Andean Crops and Grazing Region.

BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce
Office of the Secretary

Recent Economic Changes in United States: Report of Committee on Recent Economic Changes of President's Conference on Unemployment. Elimination of Waste Series: iv-32 pages. Price, 5 cents.

Report on a survey of the changes which have taken place in economic conditions in the United States since the World War. An appendix contains an outline of the report on the various phases of our present-day economic life made by the National Bureau of Economic Research to the Committee on Recent Economic Changes.

Radio Service Bulletin, April, 1929. 23 pages. Single copies, 5 cents; annual subscription, 25 cents.

Issued monthly by the Radio Division of the Department of Commerce. Contains list of radio stations and references to current radio literature.

Air Commerce Bulletin, July 15, 1929. 29 pages.

This bulletin is issued semimonthly by the Aeronautics Branch of the Department of Commerce and contains short articles on aviation developments. It contains a list of air transport routes and airway maps of the United States.

Same, August 1, 1929. 23 pages.

Radio Service Bulletin, June, 1929. 33 pages. Price, 15 cents.

Issued monthly by the Radio Division of the Department of Commerce. Contains list of radio stations and references to current radio literature.

Sap Stains of Wood and Their Prevention. By Ernest E. Hubert. viii-77 pages, 37 illustrations. Price, 35 cents.

This is one of a series of reports on the marketing and use of lumber issued by the National Committee on Wood Utilization.

Aeronautics Trade Directory; Part I, Commodities; Part II, Activities. Aeronautics Bulletin No. 3: ii-53 pages.

Air Commerce Bulletin, July 1, 1929. 22 pages.

This bulletin is issued semimonthly by the Aeronautics Branch of the Department of Commerce and contains short articles on aviation developments. It contains a list of air transport routes and an airway map of the United States.

Airport Rating Regulations, Effective as Amended January 1, 1929. Aeronautics Bulletin No. 16: ii-23 pages, 3 charts.

Seasoning, Handling, and Care of Lumber. Report of Manufacturers' Subcommittee of National

Committee on Wood Utilization. (Manufacturers' edition.) viii-126 pages, 62 illustrations, 2 charts. Price, 30 cents.

Description of the different methods employed in seasoning and care of lumber. A bibliography is included.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE

Monthly Summary of Foreign Commerce of United States. March, 1929. Parts I and II. Single copies, Part I, 10 cents; Part II, 5 cents. Annual subscription, \$1.25.

Part I contains statistics of exports of domestic merchandise, and imports by articles for March, 1928 and 1929, and for three months ended March, 1928 and 1929. Part II contains summaries of export and import trade; monthly average import and export prices; and statistics of trade with Alaska, Hawaii, and Porto Rico.

Retail Grocers' Problems. Distribution Cost Studies No. 5; iv-25 pages, 6 illustrations. Price, 10 cents.

Glossary of Paper Terms and Instructions to Exporters for Guidance in Properly Listing and Classifying Exports of Paper and Paper Products on Shippers' Export Declarations. Reprint, April, 1928, with corrections. vi-22 pages, 1 illustration.

Index to Commerce Reports, Nos. 1-12. Vol. 1, Thirty-second Year, January-March, 1929. ii-xxiv pages. Single copies, 5 cents; annual subscription, 20 cents.

Sales Territories in Middle Asia and Philippine Islands. ii-24 pages, map.

This pamphlet contains a brief account of the methods of distribution of imports in Far Eastern countries. The factors to be considered in the selection of agents for this purpose are discussed and suggestions are given for the division of the sales territory. Some statistics are included showing the distance from Singapore to some of the principal towns of the Orient. There is also an article on the Philippines indicating its importance as a market.

Canadian Loan Corporations. Trade Information Bulletin No. 616; ii-32 pages. Price, 10 cents.

European Motion-Picture Industry in 1928. Trade Information Bulletin No. 617; ii-74 pages, 2 charts. Price, 10 cents.

Markets for Dairy Equipment and Supplies in Continental Europe. Trade Information Bulletin No. 618; ii-58 pages. Price, 10 cents.

Data regarding the sanitary supervision of milk, distribution methods, manufacture of milk

products, and markets for dairy equipment in European countries.

European Markets for American Motion-Picture Equipment. Trade Information Bulletin No. 619; ii-56 pages. Price, 10 cents.

Japanese Trade in Iron and Steel Products. Trade Information Bulletin No. 615; ii-30 pages. Price, 10 cents.

This bulletin describes the trade organizations in the steel industry of Japan, the origin of imports, government assistance given the industry, classes of steel products entering into the import trade, and the kind of products exported.

Markets for Foodstuffs in Netherland East Indies. Trade Information Bulletin No. 620; ii-45 pages. Price, 10 cents.

This bulletin deals with the extent of the market for foodstuffs, the methods of distribution and the quantities of different products imported in Netherland East Indies.

British Chemical Trade in 1928. Trade Information Bulletin No. 621; ii-40 pages. Price, 10 cents.

Trading Under Laws of Argentina. By Joaquin Servera. Trade Promotion Series No. 74; viii-155 pages. Price, 25 cents.

International Fairs and Expositions. Trade Promotion Series No. 75; iv-76 pages, 16 illustrations. Price, 20 cents.

This publication contains a brief discussion of the value of fairs, with an account of the various expositions held annually in different countries.

International Trade in Citrus Fruits. Trade Promotion Series No. 77; ii-46 pages, 6 illustrations, 12 charts. Price, 10 cents.

Discussion of the principal countries producing citrus fruits, the world trade in these products, and the markets for United States fruit.

American Chemical Industry: Production and Foreign Trade in First Quarter of Twentieth Century. Trade Promotion Series No. 78; vi-114 pages, 1 illustration, 15 charts. Price, 20 cents.

Commerce Yearbook, 1929: Vol. I, United States. xxii-720 pages, 1 illustration, 152 charts, 2 maps. Price, \$1.00.

This volume of the Commerce Yearbook contains statistics concerning business conditions in the United States and its noncontiguous possessions.

Monthly Summary of Foreign Commerce of United States, June, 1929. Parts I and II. Single copies, Part I, 10 cents; Part II, 5 cents; annual subscription, \$1.75.

Part I contains statistics of exports of domestic merchandise, and imports by articles for June, 1928 and 1929, and for six months ended June, 1928 and 1929. Part II contains summaries of export and import trade; monthly average import and export prices; and statistics of trade with Alaska, Hawaii, and Porto Rico.

Motion Pictures in Japan, Philippine Islands, Netherland East Indies, Siam, British Malaya, and French Indo-China. Trade Information Bulletin No. 634; ii-27 pages. Price, 10 cents.

Flour Markets of Central America. Trade Information Bulletin No. 635; ii-11 pages. Price, 10 cents.

Study of the flour market conditions in Central American countries, with information relative to methods of sale, customs duties, size of packages, and kinds of flour preferred.

Banking and Trade Financing in United Kingdom. Trade Information Bulletin No. 636; ii-32 pages. Price, 10 cents.

Foreign Trade of United States in Calendar Year 1928, According to International Statistical Classification. Trade Information Bulletin No. 637; ii-9 pages. Price, 10 cents.

This publication consists of statistical tables.

Industrial Machinery in Italy. Trade Information Bulletin No. 638; ii-34 pages. Price, 10 cents.

This bulletin deals with the machinery industry of Italy, the amount of capital invested, the growth of trade in this class of manufactures, and the market outlook for American products.

Iron and Steel Trade and Industry of Great Britain. Trade Information Bulletin No. 639; ii-20 pages. Price, 10 cents.

Leather Trade of Netherlands. Trade Information Bulletin No. 640; ii-18 pages. Price, 10 cents.

Study of the development of the leather industry and trade of the Netherlands.

Trends in Japan's Trade and Industries. Trade Information Bulletin No. 642; ii-26 pages. Price, 10 cents.

This bulletin discusses the agricultural and industrial development, forest and mineral resources, and trends of trade of Japan.

Monthly Summary of Foreign Commerce of United States, May, 1929. Parts I and II. Single copies, Part I, 10 cents; Part II, 5 cents. Annual subscription, \$1.25.

Part I contains statistics of exports of domestic merchandise and imports by articles for May, 1928 and 1929, and for five months ended May, 1928 and 1929. Part II contains summaries of export and import trade; monthly average import and export prices; and statistics of trade with Alaska, Hawaii, and Porto Rico.

Commercial and Industrial Organizations of United States. Revised edition. Domestic Commerce Series No. 5; vi-272 pages. Price, 60 cents.

This publication contains alphabetical and classified lists of national, international, and interstate organizations doing business in the

United States; and lists of local associations of towns, arranged alphabetically under the different States.

Foreign Commerce and Navigation of United States for Calendar Year 1927. Vol. II, vi-212 pages. Price, \$1.25.

Automotive Market in Uruguay. Trade Information Bulletin No. 628; ii-25 pages. Price, 10 cents.

Automotive Markets of Scandinavian Countries and Finland. Trade Information Bulletin No. 629; ii-55 pages. Price, 10 cents.

Motion Pictures in Argentina and Brazil. Trade Information Bulletin No. 630; ii-18 pages. Price, 10 cents.

Marketing of Mercury. Trade Information Bulletin No. 631; ii-16 pages. Price, 10 cents.

Million-Dollar Markets for American Leather. Trade Information Bulletin No. 632; ii-52 pages. Price, 10 cents.

Marketing Industrial Machinery in Netherland East Indies. Trade Information Bulletin No. 633; ii-23 pages. Price, 10 cents.

Mineral Raw Materials, Survey of Commerce and Sources in Major Industrial Countries. Trade Promotion Series No. 76; viii-278 pages, 17 charts. Price, 45 cents.

This is a survey by countries of the sources of mineral raw materials, with production statistics for the years 1923 to 1927.

Handbook of Foreign Tariffs and Import Regulations on Agricultural Products I, Fresh Fruits and Vegetables, by Robert S. Hollingshead and Roberta P. Wakefield. Trade Promotion Series No. 79; vi-109 pages. Price, 20 cents.

This is the first of a series of handbooks on customs duties and import regulations for agricultural products, particularly foodstuffs, in various countries.

Latin American and Canadian Markets for American Motion-Picture Equipment. Trade Information Bulletin No. 641. Price, 10 cents.

The Marketing of Tungsten Ores and Concentrates. Trade Information Bulletin No. 643. Price, 10 cents.

Export Markets for American Brushes. Trade Information Bulletin No. 645. Price, 5 cents.

Boot and Shoe Industry and Trade in Germany. Trade Information Bulletin No. 646. Price, 10 cents.

Cattle Raising in Argentina. Trade Information Bulletin No. 647. Price, 5 cents.

American Underwriting of German Securities. Trade Information Bulletin No. 648. Price, 10 cents.

Employment and Cost of Living for Americans in the Far East. Division of Regional Information Far Eastern Section.

The bureau keeps in touch with employment and general living conditions in foreign countries

and is prepared to furnish those interested with timely information along these lines.

Sales Territories in China. By Charles K. Moser, Chief, Far Eastern Section Division of Regional Information.

Taxation of Business in Italy. By Mitchell B. Carroll, Chief, Section of Taxes and Corporations Division of Commercial Laws. Trade Promotion Series No. 82. Price, 20 cents.

In preparing the bulletin the author not only had recourse to the pertinent laws and to authoritative texts concerning them, but also consulted with Italian tax officials, lawyers, international accountants, and business men to obtain a knowledge of the practical aspects of taxation.

Public Finances of Far Eastern Countries. By Herbert M. Bratter, Finance & Investment Division. Trade Promotion Series No. 83. Price, 20 cents.

American investments in far eastern countries have steadily mounted in recent years. Estimates of the Bureau of Foreign and Domestic Commerce covering security issues publicly offered in the United States from 1914 to 1928, inclusive, total \$851,258,680 for far eastern countries other than United States possessions. Of that amount roughly three-fourths, or \$640,397,000, was invested in governmental, provincial, and municipal issues.

These figures, coupled with the growing trade of the United States with the far eastern countries, are an indication of the need for current information on the public finances of the various countries. To meet this need the present study, the fourth of a series, has been prepared. It is based on official sources wherever obtainable and on the reports submitted by the foreign representatives of the Department of State and of the Department of Commerce.

LIGHTHOUSE SERVICE

Light List, Including Fog Signals, Buoys, and Daymarks, Great Lakes, United States and Canada, 1929 (corrected to March 1). ii-259 pages. Price, 30 cents.

This list describes all aids to navigation maintained by the United States and Canada on the Great Lakes and on the St. Lawrence River above St. Regis River.

Atlantic Coast of United States: Local Light List, Including Lights, Fog Signals, Buoys, and Daymarks, Cape May to Cape Lookout, Including Delaware and Chesapeake Bays and North Carolina Sounds, Fourth and Fifth Lighthouse Districts, 1929 (corrected to December 15, 1928). 415 pages. Price, 30 cents.

This list describes all aids to navigation maintained by the United States in the districts stated.

Atlantic Coast of United States: Local Light List, Including Lights, Fog Signals, Buoys, and

Daymarks, New England Coast, Maine to Massachusetts, First and Second Lighthouse Districts, 1929 (corrected to December 15, 1928). ii-182 pages. Price, 30 cents.

This list describes all aids to navigation maintained by the United States on the New England coast.

Light List, Including Fog Signals, Pacific Coast, United States, Canada, Hawaiian and Samoan Islands, 1929 (corrected to January 1). 245 pages. Price, 30 cents.

This list describes all aids to navigation maintained by the United States on the Pacific coast of the United States, and on the coasts of Alaska and the Hawaiian, Midway, Guam, and Samoan Islands.

Local Light List, Including Lights, Fog Signals, Buoys, and Daymarks, California and Oregon, including Columbia River, 1929 (corrected to January 1). 144 pages. Price, 20 cents.

This list describes all aids to navigation maintained by the United States within the limits stated.

Local Light List, Including Lights, Fog Signals, Buoys, and Daymarks, Cape Lookout to Hillsboro Inlet, 1929 (corrected to December 15, 1928). 429 pages. Price, 30 cents.

This list describes all aids to navigation maintained by the United States in the districts stated.

Local Light List, Including Lights, Fog Signals, Buoys, and Daymarks, New York and Approaches, Narragansett Bay to Cape May, 1929 (corrected to December 15, 1928). Price, 20 cents.

This list describes aids to navigation maintained by the United States in the districts stated.

Local Light List, Including Lights, Fog Signals, Buoys, and Daymarks, Washington to Alaska, Including British Columbia, 1929 (corrected to January 1). 298 pages. Price, 25 cents.

This list describes aids to navigation maintained by the United States in the districts stated.

Lighthouse Service Bulletin No. 67, July, 1929. Vol. III. Issued monthly. (pp. 265-298.)

PATENT OFFICE

General Information Concerning Patents. 24 pages, 2 illustrations. Price, 5 cents.

Classification Bulletin of United States Patent Office, January 1, 1928-December 31, 1929. Containing Classification of Subjects of Invention Revised by Classification Division of United States Patent Office. No. 60. Price, 10 cents.

BUREAU OF THE CENSUS

Stocks of Leaf Tobacco, and American Production, Imports, Exports, and Consumption of Tobacco and Tobacco Products, 1928. Bulletin 165; 43 pages, 1 illustration. Price, 10 cents.

Census of Manufactures, 1927:

Wood Distillation and Charcoal Manufacture. 11 pages. Price, 5 cents.

Caskets, Coffins, Burial Cases, and Morticians' Goods. 7 pages. Price, 5 cents.

Prime Movers, Motors, and Generators; Coal Consumed. 23 pages. Price, 5 cents.

Statistics for Cities. 86 pages. Price, 15 cents.

This publication gives statistics for industries in towns of 100,000 inhabitants or more.

Manufactured Ice; Refrigerators and Refrigerator Cabinets (exclusive of Mechanical Refrigerating Equipment) and Mechanical Refrigerators.

Furniture (Preliminary reports for this industry were issued November 15, 1928, and January 12, 1929), *Mattresses and Bed Springs* (A preliminary report for this industry was issued January 18, 1929). 17 pages. Price, 5 cents.

Turpentine and Rosin. 8 pages. Price, 5 cents.

Statistics for Industries and States. 109 pages. Price, 15 cents.

Cotton Production in the United States, Crop of 1928. 40 pages. Price, 10 cents.

This publication contains tables showing the amount of the cotton crop, the number of ginneries in operation, and the amount of cotton ginned in the various cotton growing states.

Marriage and Divorce, 1927. Statistics of Marriages, Divorces, and Annulments of Marriage. 90 pages. Price, 15 cents.

Fifteenth Census of the United States. Instructions to Supervisors. 53 pages.

Animal and Vegetable Fats and Oils; Production, Consumption, Imports, Exports, and Stocks, by Quarters, Calendar Year 1927 and 1928. 18 pages. Price, 5 cents.

Census of Religious Bodies, 1926; Jewish Congregations, Statistics, History, Doctrine, and Organization. 24 pages. Price, 5 cents.

Financial Statistics of States, 1927. vi-125 pages, 8 diagrams. Price, 20 cents.

This publication contains tables giving the financial condition and transactions of the different States during 1927.

Fourteenth Census of United States Population: Population of Incorporated Places. (Reprint from Fourteenth Census Reports, Vol. 1, tables 51 and 52, pp. 178-331.)

These tables give the population of towns with 5,000 inhabitants and over for the years 1900, 1910, and 1920.

BUREAU OF STANDARDS

Brass Pipe Nipples. Commercial Standard CS10-29; iv-14 pages, 1 illustration. Price, 5 cents.

Determination of Source and Means of Prevention of Stones in Glass. By Herbert Insley. Research Paper No. 71. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1077-1084, 7 pages of plates, 2 diagrams. Price, 5 cents.

Study of the materials used in making glass in an endeavor to discover the sources of stones formed and methods of preventing their occurrence.

Simplified Practice Recommendations:

R96-28, Ice Cake Sizes. ii-18 pages, 1 chart. Price, 5 cents.

R98-29. Photographic Paper, x-12 pages, 1 chart. Price, 10 cents.

Technical News Bulletin, July, 1929. Pages 61-72. Annual subscription, 25 cents.

This monthly publication contains a brief account of the laboratory activities of the bureau and gives a list of pamphlets issued and magazine articles published during the preceding month.

Ship Propellers Specifications: Built-up Propellers, Templates for Propeller Blade Flanges and Bolt Holes, Propellers Cast in One Piece, compiled and promulgated by American Marine Standards Committee. American Marine Standards E, No. 23, 1928, to E, No. 25, 1928, inclusive; vi-13 pages, 3 illustrations. Price, 10 cents.

Fittings for Tubular Steel Cargo Booms, Heel Fittings and Caps for 5, 10, 15, 20, and 30 Ton Booms, compiled and promulgated by American Marine Standards Committee. American Marine Standards H, No. 30, 1928, and H, No. 31, 1929; ii-3 pages, 2 illustrations. Price, 5 cents.

Medical Equipment for Ocean-Going Vessels; Medicine Chest Specification, Medical and Surgical Supplies and Equipment Standard Unit List, compiled and promulgated by American Marine Standards Committee. American Marine Standards H, No. 32, 1928, and O, No. 21, 1928; ii-8 pages, 3 illustrations. Price, 5 cents.

Medical Equipment for Coastwise and Lake Freighters: Medicine Chest Specification, Medical and Surgical Supplies and Equipment Standard Unit List, compiled and promulgated by American Marine Standards Committee. American Marine Standards H, No. 33, 1928, and O, No. 22, 1928; ii-8 pages, 3 illustrations. Price, 5 cents.

Medical Equipment for Small Vessels: Medicine Chest Specification, Medical and Surgical Supplies and Equipment Standard Unit List, compiled and promulgated by American Marine Standards Committee. American Marine Standards H, No. 34, 1928, and O, No. 23, 1928; ii-4 pages, 1 illustration. Price, 5 cents.

Bureau of Standards Journal of Research, July, 1929. Pages 1-190, illustrations, plates,

charts. Single copies, 25 cents; annual subscription, \$2.75.

This journal contains the papers formerly issued as the Technologic and Scientific Papers series, which series have been discontinued. The articles in the journal are known as the Research Papers series and are issued separately after publication in the journal.

Experimental Production of Roofing Felts. By Merele B. Shaw, George W. Bicking, and O. G. Strieter. Research Paper No. 67. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1001-1016. Price, 5 cents.

Bearing Bronzes with and without Zinc. By H. J. French and E. M. Staples. Research Paper No. 68. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1017-1038, 8 illustrations, 9 pages of plates. Price, 15 cents.

Critical Study of Methods of Measuring Bulk of Paper. By F. T. Carson. Research Paper No. 69. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1039-1056, 1 illustration, 1 plate, 4 charts. Price, 10 cents.

Some Observations of Short-Period Radio Fading. By T. Parkinson. Research Paper No. 70. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1057-1075, 17 illustrations. Price, 5 cents.

Spotting of Plated or Finished Metals. By W. P. Barrows. Research Paper No. 72. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1085-1116, 1 illustration, 1 plate. Price, 10 cents.

Arc Spectrum of Chlorine and its Structure. By C. C. Kiess and T. L. DeBruin. Research Paper No. 73. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1117-1136, 2 illustrations, 2 pages of plates. Price, 5 cents.

Potential Differences Across Boundaries Between Solutions of Mixed Univalent Chlorides. By Edgar Reynolds Smith. Research Paper No. 74. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1137-1143, 1 illustration. Price, 5 cents.

Accurate Determination of Gasoline Content of Natural Gas and Analytical Separation of Natural Gases by Fractional Isothermal Distillation. By Martin Shepherd. Research Paper No. 75. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1145-1199, 10 illustrations, 5 plates, 9 charts. Description of methods and apparatus used in determining gasoline content of natural gas. Price, 15 cents.

Relation of Radio Wave Propagation to Disturbances in Terrestrial Magnetism. By Ivy Jane Wymore. Research Paper No. 76. Reprint from Bureau of Standards Journal of Research, Vol. 2, June, 1929, pp. 1201-

- 1211, 6 charts. Study of effects of magnetic storms on radio transmission. Price, 5 cents.
- Wrought Iron Pipe Nipples.* Commercial Standard CS6-29, Elimination of Waste Series; iv-14 pages, 1 illustration. Price, 10 cents.
- Simplified Practice Recommendation R8-29: Range Boilers and Expansion Tanks.* vi-18 pages, 6 illustrations. (Supersedes R8.) Price, 10 cents.
- United States Government Master Specifications.* These specifications for the purchase of materials for the use of Government departments are promulgated by the Federal Specifications Board and published by the Bureau of Standards. Those listed below by number may be obtained at 5 cents each:
- No. 254c. Denim, Brown (Shrunk). ii-2 pages. Supersedes Federal Specifications Board Specification No. 354h and Bureau of Standards Circular 256.
- No. 255b. Denim, Brown (Unshrunk). ii-2 pages. Supersedes Federal Specifications Board Specification No. 255a and Bureau of Standards Circular 259.
- No. 256c. Denim, Blue (Shrunk). ii-3 pages. Supersedes Federal Specifications Board Specification 256b and Bureau of Standards Circular 265.
- No. 257b. Denim, Blue (Unshrunk). ii-3 pages. Supersedes Federal Specifications Board Specification No. 257a and Bureau of Standards Circular 266.
- Bureau of Standards Journal of Research, May, 1929.* Pages 837-999, illustrations, plates, charts. Price, single copies, 25 cents; annual subscription, \$2.75.
- This journal contains the papers formerly issued as the Technologic and Scientific Papers series, which series have been discontinued. The articles in the journal are known as the Research Papers series and are issued separately after publication in the journal.
- Continuous Spectrum X Rays from Thin Targets.* By Warren W. Nicholas. Research Paper No. 60. Reprint from Bureau of Standards Journal of Research, Vol. 2, May, 1929, pp. 837-870, 16 illustrations. Price, 10 cents.
- Multiple-Strand Test for Yarns.* By Charles W. Schoffstall and H. A. Hamm. Research Paper No. 61. Reprint from Bureau of Standards Journal of Research, Vol. 2, May, 1929, pp. 871-885, 4 illustrations, 2 pages of plates.
- Thermal Expansion of Tantalum.* By Peter Hidnert. Research Paper No. 62. Reprint from Bureau of Standards Journal of Research, Vol. 2, May, 1929, pp. 887-896, 5 illustrations. Data on the expansion of tantalum at different temperatures. Price, 5 cents.
- Prism Refractometry and Certain Goniometrical Requirements for Precision.* By L. W. Titon. Research Paper No. 64. Reprint from Bureau of Standards Journal of Research, Vol. 2, May, 1929, pp. 909-930, 2 illustrations. Price, 10 cents.
- New Determination of Melting Point of Palladium.* By C. O. Fairchild, W. H. Hoover and M. F. Peters. Research Paper No. 65. Reprint from Bureau of Standards Journal of Research, Vol. 2, May, 1929, pp. 931-962, 3 illustrations. Price, 10 cents.
- New Seismometer Equipped for Electromagnetic Damping and Electromagnetic and Optical Magnification (Theory, General Design, and Preliminary Results).* By Frank Wenner. Research Paper No. 66. Reprint from Bureau of Standards Journal of Research, Vol. 2, May, 1929, pp. 963-999, 4 illustrations, 6 pages of plates, 6 charts. Report on experiments with a new type of seismometer. Price, 15 cents.
- Recommended Specification for Quicklime and Hydrated Lime for Use in Soap Making.* Circular 372: ii-6 pages. Price, 5 cents.
- Staple Porcelain (All-Clay) Plumbing Fixtures.* Commercial Standard CS4-29; vi-28 pages, 24 illustrations. Price, 10 cents.
- Simplified Practice Recommendation R95-28: Skid Platforms.* vi-18 pages, 1 chart. Price, 5 cents.
- Technical News Bulletin, May, 1929.* Pages 37-48. Annual subscription, 25 cents.
- This monthly publication contains a brief account of the laboratory activities of the bureau and gives a list of pamphlets issued and magazine articles published during the preceding month.
- United States Government Master Specifications.* These specifications for the purchase of materials for the use of Government departments are promulgated by the Federal Specifications Board and published by the Bureau of Standards. Those listed below by number may be obtained at 5 cents each:
- No. 39c. Tubing, Rubber. ii-3 pages. Supersedes Federal Specification Board Specification No. 39b and Bureau of Standards Circular No. 305.
- No. 48c. Hose, Water and Wash Deck. ii-3 pages. Supersedes Federal Specifications Board Specification No. 48b and Bureau of Standards Circular No. 291.
- No. 50b. Hose, Suction, Water (Smooth Bore). ii-4 pages. Supersedes Federal Specifications Board Specification No. 50a and Bureau of Standards Circular No. 292.
- No. 111b. Packings and Gaskets, Rubber (Molded, Sheet, and Strip). ii-4 pages. Supersedes Federal Specifications Board Specification No. 111a and Bureau of Standards Circular No. 235.
- No. 497a. Wool Bunting. ii-2 pages. Supersedes Federal Specifications Board Spec-

- fication No. 497 and Bureau of Standards Circular C355.
- No. 618. Lamps, Electric, Incandescent, Miniature, Tungsten Filament. ii-10 pages.
- No. 63c. Hose, Oil Suction and Discharge. ii-4 pages. Supersedes Federal Specifications Board Specification No. 63b and Bureau of Standards Circular No. 209.
- No. 588. Hose, Water, Braided. ii-3 pages.
- No. 258b. Cloth, Airplane, Mercerized Cotton, Grade A. ii-3 pages. Supersedes Federal Specifications Board Specification No. 258a and Bureau of Standards Circular No. 270.
- No. 345a. General Specification for Textile Materials (Methods of Physical and Chemical Tests). ii-6 pages. Supersedes Federal Specifications Board Specification No. 345 and Bureau of Standards Circular No. 293.
- Steel Pipe Nipples*. Commercial Standard CS5-29, Elimination of Waste through Simplified Commercial Practice; iii-14 pages. 1 illustration. Price, 10 cents.
- Technical News Bulletin, June, 1929*. Pages 49-60. Annual subscription, 25 cents.
- Simplified Practice Recommendation R28-29: Sheet Steel*. ix-18 pages; 1 chart. Price, 10 cents.
- Alphabetical Index and Numerical List of United States Government Master Specifications*, promulgated by the Federal Specifications Board. Circular of the Bureau of Standards, No. 371. Supersedes Circular 319, 2nd ed.
- Bureau of Standards Journal of Research, August, 1929*. Pages 191-341, illustrations, plates, charts. Price, single copies, 25 cents; annual subscription, \$2.75.
- This journal contains the papers formerly issued as the Technologic and Scientific Papers series, which series have been discontinued. The articles in the journal are known as the Research Papers series and are issued separately after publication in the journal.
- Report of the National Screw Thread Commission*. (Revised, 1928) Miscellaneous publications of the Bureau of Standards, No. 89. vi-261 pages, illustrations, plates, charts. Price, 50 cents.
- Commercial Standards Monthly, August, 1929, Vol. 6, No. 2*. Subscription Price, \$1.00 per year.

This new governmental periodical is a review of progress in commercial simplification and standardization.

BUREAU OF MINES

- Bibliography of Petroleum and Allied Substances, 1922 and 1923*. By H. Britton. Bulletin 290; ii-667 pages. Price, \$1.00.
- Methods, Costs, and Safety in Stripping and Mining Coal, Copper Ore, Iron Ore, Bauxite, and Pebble Phosphate*. Bulletin 298; x-275 pages, 118 illustrations, 2 charts, map. Price, 70 cents.
- This publication contains an account of the methods and costs of open pit mining. There are descriptions of the kinds of machinery used and some reports are given relative to accidents in open pit mines in various States.
- Strontium from Domestic Standpoint*. By R. M. Santmyers. Economic Paper 4; ii-19 pages. Price, 5 cents.
- This paper contains a statement of the localities in the United States and other countries where strontium deposits have been found, the amount produced in the different countries, and the purposes for which this mineral is used.
- Mineral Resources of United States, 1927*. The reports on mineral resources are first issued in the form of bulletins of which the following have been released since the July announcement and may be obtained at the price indicated:
- Coke and By-Products in 1927. (Pt. II, pp. 595-687.) Price, 15 cents.
- Zinc in 1927. (Pt. I, pp. 479-507.) Price, 5 cents.
- Advanced Mine Rescue Training: Part IV, Suggested Procedure in Sealing and Unsealing Mine Fires and in Recovery Operations*. By J. J. Forbes and G. W. Groves. Miners' Circular 36; iv-54 pages, 22 illustrations, 2 plates. Price, 15 cents.
- Methods of Analyzing Coal and Coke*. By F. M. Stanton and A. C. Fieldner, revised by W. A. Selvig. Technical Paper 8; iv-47 pages, 13 illustrations, 1 plate. Price, 15 cents.
- Inflammability of Mixed Gases*. By G. W., Jones. Technical Paper 450; iv-38 pages, 6 illustrations. Price, 10 cents.
- Calcium Sulphate Retarders for Portland Cement Clinker*. By Ernest E. Berger. Technical Paper 451; ii-35 pages, 1 illustration, 1 plate, 6 charts. Price, 10 cents.
- Tests of Strength of Roof Supports Used in Anthracite Mines of Pennsylvania*. Bulletin 303; iv-44 pages, 30 illustrations. Price, 15 cents.
- This is a report of the United States Bureau of Mines to the Pennsylvania State Anthracite Mine Cave Commission and a review of the compressive strength of anthracite, bituminous coals, and mine supports.
- Mineral Resources of United States, 1927*. The reports on mineral resources are first issued in the form of bulletins of which the following have been released since the August announcement and may be obtained at the price indicated:
- Gold and Silver in 1927. (Pt. I, pp. 599-636.) Price, 10 cents.

- Gold, Silver, Copper, Lead, and Zinc in Colorado in 1927. (Pt. I, pp. 527-572.) Price, 10 cents.
- Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1927. (Pt. I, pp. 573-598.) Price, 5 cents.
- Gold, Silver, Copper, Lead, and Zinc in Nevada in 1927. (Pt. I, pp. 509-525.) Price, 5 cents.
- Coal in 1927. (Pt. II, pp. 327-509.) Price, 30 cents.
- Mineral Resources of United States, 1928.* Fluorspar and Cryolite in 1928. (Pt. II, pp. 13-30.) Price, 5 cents.
- Permissible Junction Boxes.* By L. C. Ilsley and R. A. Kearns. Technical Paper 454; ii-19 pages, 3 illustrations, 2 plates. Price, 10 cents.
- Report on investigation of junction boxes used to protect electrical cables, with description of types declared permissible in mines.
- Carburetion of Combustible Gas with Butane and Propane-Butane Mixtures, with Particular Reference to Carburetion of Water Gas.* Bulletin 294; vi-96 pages, 2 illustrations, 2 plates, 14 charts. Price, 25 cents.
- Iron Oxide Reduction Equilibria: Critique from Standpoint of Phase Rule and Thermodynamics.* Bulletin 296; x-326 pages, 8 illustrations, 104 charts. Price, 60 cents.
- Metallurgical Limestone: Problems in Production and Utilization.* Bulletin 299; iv-40 pages, 4 illustrations. Price, 10 cents.
- Discussion of the varieties and physical characteristics of limestone and some of the problems connected with its utilization for metallurgical purposes.
- Summarized Data of Zinc Production, Showing Relation of Production in United States to that of the World.* By Elmer W. Pehrson and Common Metals Division, Economics Branch. Economic Paper 2; iv-47 pages, 18 illustrations, 1 table, 2 maps. Price, 15 cents.
- Data showing production of zinc in different countries of the world since 1801.
- Historical Summary of Gold, Silver, Copper, Lead, and Zinc Produced in California, 1848-1926.* Economic Paper 3; ii-22 pages, 3 diagrams. Price, 5 cents.
- Mineral Resources of United States, 1927.* The reports on mineral resources are first issued in the form of bulletins of which the following have been released since the May announcement and may be obtained at the price indicated:
- Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas in 1927. (Pt. I, pp. 455-479.) Price, 10 cents.
- Petroleum in 1927. (Pt. II, pp. 511-593.) Price, 15 cents.
- Rare Metals: Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1927. (Pt. I, pp. 393-453.) Price, 10 cents.
- Secondary Metals in 1927. (Pt. I, pp. 373-392.) Price, 5 cents.
- Falls of Roof in Bituminous Coal Mines, Influence of Seasons and Rate of Production.* By J. W. Paul. Technical Paper 410; ii-40 pages, 25 charts. Price, 10 cents.
- Discussion of the effect of changes in temperature on the roof of coal mines and the ratio of production to the number of accidents occurring in these mines, with recommendations for their prevention.
- Coal-Dust Explosions in Mines, Causes, Effects, and Recommendations for Prevention.* Technical Paper 448; ii-24 pages. Price, 5 cents.
- Study of Crude Oil Produced in Salt Creek Field, Wyoming.* Technical Paper 449; ii-27 pages, 5 illustrations. Price, 5 cents.
- Safety Organizations in Arizona Copper Mines.* Technical Paper 452; ii-49 pages. Price, 10 cents.
- Inspection and Testing of Mine-Type Electrical Equipment for Permissibility.* Bulletin 305; ii-26 pages; 5 illustrations, 1 chart. Price, 10 cents.
- Mineral Resources of United States, 1928.* The reports on mineral resources are first issued in the form of bulletins of which the following have been released since the June announcement and may be obtained at the price indicated:
- Fuel Briquets in 1928. (Pt. II, pp. 1-11.) By O. E. Kiessling and J. M. Corse. Price, 5 cents.

COAST AND GEODETIC SURVEY

- Geodetic Surveys, Methods, Instruments, and Purposes.* Revised edition. Serial No. 257; ii-18 pages.
- Tide Tables, Pacific Coast, North America, Eastern Asia, and Island Groups for Year 1930.* Series No. 438; 476 pages. Price, 15 cents.
- The tables in this publication give the predicted times and heights of tide for each day of the year at different places on the Pacific Coast of the United States and Alaska, and at different places in the countries and islands of the Far East. Data are also given on the rising and setting of the sun and moon in different latitudes.
- Tide Table, Boston Harbor and Vicinity for Year 1930.* Serial No. 447; ii-22 pages. Price, 5 cents.
- This publication gives the times of high and low tide in Boston Harbor and vicinity; and the times of rising and setting of the sun and moon in this region.
- Tide Table, New York Harbor and Vicinity for Year 1930.* Serial No. 450; ii-23 pages. Price, 5 cents.

These tables show the times of the tides in New York Harbor and vicinity and the times of rising and setting of the sun and moon in New York City.

Current Tables, Atlantic Coast, North America, for Year 1930. Serial No. 430; 126 pages, 2 illustrations, 6 diagrams. Price, 10 cents.

There is an explanatory introduction with each set of tables.

Current Tables, Pacific Coast, North America and Philippine Islands, for Year 1930. Serial No. 432; 113 pages, 4 illustrations, 5 diagrams. Price, 10 cents.

These tables show the velocity of currents and the time of incoming and outgoing tides in Pacific Coast waters.

Catalogue of U. S. Coast and Geodetic Survey Charts, Maps, Coast Pilots, Tide Tables, Current Tables, April 1, 1929. Serial No. 437; 48 pages, 18 illustrations.

Radio Acoustic Position Finding. Supplement to Coast and Geodetic Special Publication No. 146; 5 pages, 2 illustrations. Description of apparatus used for sound experiments in deep water.

Coast and Geodetic Survey Bulletin No. 168, May, 1929. (Issued monthly.) Hydrographic and Topographic Work. 10 pages.

Coast and Geodetic Survey Bulletin No. 169, June, 1929. (Issued monthly.) Hydrographic and Topographic Work. 8 pages.

Coast and Geodetic Survey Bulletin No. 170, July, 1929. (Issued monthly.) Hydrographic and Topographic Work. 10 pages.

Supplement to United States Coast Pilot, Atlantic Coast, Section A, St. Croix River to Cape Cod. Second (1927) Edition. Serial No. 448; 10 pages.

Supplement to United States Coast Pilot, Atlantic Coast, Section C, Sandy Hook to Cape Henry. Serial No. 449. 33 pages.

Tide Tables, Atlantic Coast, North America, for Year 1930. Serial No. 435; 475 pages. Price, 15 cents.

Manual of Second and Third Order Triangulation and Traverse. Special Publication No. 145. v-226 pages. Price, 60 cents.

BUREAU OF FISHERIES

Propagation and Distribution of Food Fishes, Fiscal Year 1928. Document No. 1049. (Appendix VIII to Report of U. S. Commissioner of Fisheries for 1928, pp. 339-399, 4 illustrations.) Price, 10 cents.

Life History of Lake Herring (Leucichthys Arctedile Sueur) of Lake Huron as Revealed by its Scales, with Critique of Scale Method. Document No. 1053. By John Van Oosten. (From Bulletin of Bureau of Fisheries, vol. XLIV, 1928, pp. 265-428, 1 illustration, 16 plates, 11 charts.) A bibliography is included. Price, 65 cents.

Investigation of Physical Conditions Controlling Spawning of Oysters and Occurrence, Distribution, and Setting of Oyster Larvae in Milford Harbor, Connecticut. Document No. 1054. (From Bulletin of Bureau of Fisheries, vol. XLIV, 1928, pp. 429-503, 15 illustrations, 17 charts.) A bibliography is included. Price, 25 cents.

Parasites of Fresh-Water Fishes, Comprising Some General Considerations. By H. S. Pratt. Economic Circular No. 42; 10 pages, 11 illustrations. Description of some of the parasites which affect and often destroy fish. Price, 5 cents.

Bulletin of the Bureau of Fisheries, Volume XLIII (1927) Part II. iv-678 pages, illustrations, charts, maps.

Index to Bulletin of the United States Bureau of Fisheries, Volume XLIII (1927) Part II.

Bulletin of the Bureau of Fisheries, Volume XLIV (1928). iv-507 pages. Illustrations, charts, maps.

Index to Bulletin of the United States Bureau of Fisheries, Volume XLIV (1928).

Fisheries Service Bulletin No. 170. (Issued monthly) July, 1929. 8 pages.

Fisheries Service Bulletin No. 169. (Issued monthly) June, 1929. 11 pages.

Fisheries Service Bulletin No. 171. (Issued monthly) August, 1929. 5 pages.

Goldfish Industry. Economic Circular No. 68; 14 pages; 5 illustrations. By Thomas Quast. Price, 5 cents.

Fishery Industries of the United States, 1927. Document No. 1050 (pp. 401-547). By Oscar E. Sette and R. H. Fiedler. Price, 25 cents.

Propagation of Pond Fishes. Document No. 1056. (pp. 19-50, 16 illustrations.) By M. C. James. Price, 10 cents.

BUREAU OF NAVIGATION

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, April, 1929. ii-72 pages. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

Merchant Marine Statistics, 1928. No. 5; iv-76 pages. Price, 15 cents.

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, July, 1929. ii-72 pages. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, May, 1929. Serial No. 138. ii-72 pages. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, June, 1929. Serial No. 139. ii-72 pages. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

STEAMBOAT INSPECTION SERVICE

Pilot Rules for Certain Inland Waters of Atlantic and Pacific Coasts and of Coast of Gulf of Mexico. Edition, May 10, 1929. Form 804; iv-36 pages, illustrations.

Laws Governing Steamboat Inspection Service. June 24, 1925. Form 800; 94 pages.

Pilot Rules for The Great Lakes and Their Connecting and Tributary Waters. Edition April 2, 1929. Form 808; ii-24 pages.

Steamboat Inspection Service. Forty-Fifth Supplement to General Rules and Regulations. File 3065. April 1, 1929. 24 pages.

Steamboat Inspection Service Bulletin No. 164. June, 1929. Issued monthly. 4 pages.

Steamboat Inspection Service Bulletin No. 165. July, 1929. Issued monthly. 3 pages.

Steamboat Inspection Service Bulletin No. 166. August, 1929. Issued monthly. 5 pages.

HELEN M. STRONG.

VAN CLEEF, EUGENE. *Finland—The Republic Farthest North.* xii and 220 pp., maps, charts, and illustrations. The Ohio State University Press, Columbus, Ohio. 1929.

Without doubt, no man in America is so well qualified to write of Finland and the Finns, as is Eugene Van Cleef. Almost twenty years have passed since he began his studies of Finnish life among the Finn immigrants of Minnesota about Duluth, and more than ten years have passed since his first publication in the field. For almost two decades Doctor Van Cleef's interest in Finland and the Finns has grown and become more substantially founded upon his knowledge of them, through continued study of the Finn groups in America, and several prolonged visits to their homeland along the Baltic. He is recognized as the foremost American authority on Finnish affairs.

This book, *Finland—The Republic Farthest North*, represents the climax of his studies thus far, rather than their culmination. It presents clearly and forcefully the influence of the geographic environment upon the Finnish life and activities throughout their history, without unduly emphasizing it, and wherever other influences have dominated, the book effectively presents them. It constitutes a well-balanced geographic treatise of an interesting land and its more interesting people and their activities.

The order of presentation is significant and somewhat unusual. The first chapter is devoted to the land, its boundaries, geology, physiographic provinces, water bodies and landscapes, each succinctly but adequately described. The second chapter describes the people, their racial origin and groupings, their movements, routes of immigration, and distinctive adjustments. Then follow climate, agriculture, forests, industries, coöperatives, inland communication, sea-faring interests, foreign trade, cities, cultural development, history, and politics in as many well-

organized, factually rich chapters. The final chapter is on "Emigration and the Finn in America," whereby the fact is brought out that the Finn settles in America generally in those regions where the physical terrain is most like that of his native land and where he may engage in activities and live his life most nearly as he did in Finland. He loves the lakes, the evergreen forests, the granite-bound hills—among them he feels most "at home," and there he may engage in lumbering, fishing, and dairying as he did "at home." His distinguishing traits, reflecting the rigorous conditions under which he lives and his ancestors have lived, are tenacity, persistence, and courage almost to the point of stubbornness, making him an ideal pioneer, to whom time and obstacles are of only incidental moment in the achievement of his purpose in "taming the land."

This book is refreshingly and invigoratingly direct and daring in its frank expression of the part that environment plays in shaping the lives of a people, determining its destiny. There is no evasion, no temporizing. The return to the old sound theses of Ritter and Ratzel and Semple is indication of the soundness of their work, never seriously disputed.

It is a valuable book, not only for the richness of its subject matter and felicity of treatment, but for the soundness of its point of view and its deductions.

W. ELMER EKBLAW.

BORDEN, MRS. JOHN. *The Cruise of the Northern Light.* 317 pp.; ill. The Macmillan Company, New York, 1928.

An expedition beyond the Arctic Circle has a fascination all its own, one which few people can resist, once the means and the opportunity present themselves. Mrs. Borden felt it when Mr. Borden suggested a pleasure trip to Alaska. It was something more than a pleasure trip, however, when the party set forth, in a yacht made to order, prepared for a five-months' cruise along the coasts of Alaska and Arctic Siberia in search of museum specimens of Alaska brown bear, polar bear, and walrus. *The Cruise of the Northern Light* is the story of this adventure.

The reader is lured from page to page of the journal, hardly wanting to pause for breath until the last page is turned. Then, one is left with impressions of a thoroughly enjoyable voyage in good company, despite an occasional rolling of the ship. Gray days of rain while hunting brown bear through miles of dreary brown brush. Days of fog in the uncharted waters of Bering Sea. High coasts, low coasts, for the most part wild and barren. Shivery thrills while dodging the grip of the polar ice-pack, trying always to keep near enough to hunt polar bear. Trying to break through ice and fog to Wrangel Island, that little-known, Arctic, halfway station, now claimed and colonized by Russia. Few people—Eskimo and a handful of whites, whose Paris is Nome and whose Bible is the Sears-Roebuck

catalogue; Chuckchees on the bleak Siberian coast, romantic because so little known. Through all, the beauty of the North—the dazzling glory of the Arctic day, the awesome glory of the Arctic night; the blues and greens of an ice-bound sea, the rose-reds of the midnight sun. Sea and ice and sky, and one white ship with tall masts. . . .

Mrs. Borden has written a book that is pleasant to read and one that paints for the reader a series of vivid pictures. In it are the discoveries of an explorer, the thrills of a hunter, and the pleasures of those who can afford the best. It is the story of an Arctic voyage *de luxe*.

PRISCILLA H. WEBSTER.

LARSSON, IVAN. *Praktisk Handelslära (Practical Tradestudies)*. 214 pp. and ills. A.-B. Hasse W. Tullbergs Förlag, Stockholm, 1929.

A practical textbook for commercial high schools and secondary colleges, this concise study of the technique of trade, transportation, storage, and advertising, if written in English would attract considerable, and probably generally favorable, attention. It includes a clear, comprehensive discussion of the bases of buying and selling, both wholesale and retail; of credit and insurance; of advertising and storage; of tariffs and duties; of markets and stores. It is written in readable Swedish, in a style that holds attention and attracts study. Safe it is to say that it fills a good place among Swedish texts in its field.

W. ELMER EKBLAW.

PÂRVAN, VASILE. *Dacia, an Outline of the Early Civilizations of the Carpatho-Danubian Countries*. Translated by I. L. Evans and M. P. Charlesworth. x and 202 pp.; bibliographical note; ills.; index, and concordance of place names; a map of ancient Dacia. Cambridge University Press, 1928.

Dacia is a series of lectures on early civilizations in the Carpathians and Lower Danubian countries delivered by Vasile Pârvan at Cambridge University. Since the author's death, the lectures have been translated into English and published as a permanent memorial. Pârvan's research has revealed a wealth of archeological finds which attest a continuous culture in the Carpathian Mountains and lower Danube Valley. Five periods of development are recognized—the Villanovan, Scythian, Greek, Celtic, and Roman. One chapter each is devoted to the characteristics and contributions of the civilization of each period.

When Dacia was incorporated as a province of the Roman Empire, it was a great kingdom based upon a homogeneous ethnic foundation: "Its historical traditions were already old, its social and economic structure was well marked, and it possessed an advanced culture, which, influenced at first by the forms of Celtic civilization, had for two centuries before Trajan felt the impress of Rome. Here was a worthy rival

even for Rome . . . a nation, organized, powerful, conscious of itself." The success of Roman colonization was due to preparatory work accomplished long before; Rome's seed fell on fertile ground.

Geographic conditions favored a quality and continuity of civilization in Dacia superior to that of adjacent regions. In the first place, Dacia occupied a central location athwart the paths of migrating peoples, many of whom sought the favorable gaps through the Carpathian Mountains in journeying westward to the Hungarian plains, or eastward into Scythia. From earliest Neolithic times people have penetrated the region and have exploited its rich resources; they established settlements and in course of time evolved a distinctive civilization. Among archeological specimens throughout the Carpathians, vases of North Italian origin point to well-established intercourse with the Mediterranean Basin during the Bronze and Iron Ages. Many Italian articles reached Galicia and Podolia through Dacia by way of trade. Successive waves of culture passed over Dacia and each left a permanent record.

Commercial highways focused on Dacia or ran near her boundaries. The Amber Route, important from earliest historic times, utilized the low Pear Tree Pass at the head of the Adriatic, reached the Danube via the Save, passed the borders of Dacia and terminated on the Baltic and North Sea coasts. Dacia therefore lay near the major north-south road between Mediterranean and Baltic Seas. The Danube River and valley provided the main east-west route through central Europe; along this stream and its principal tributaries Greek factories were numerous. From these trading posts and from Greek cities on the Black Sea (Olbia and Istria) Hellenic influence penetrated far into Dacia, following the major streams of the Danube system.

A factor of dominant significance was the presence of rich and varied mineral wealth in the Carpathians and Transylvanian Alps. Gold, silver, copper, iron, and salt attracted a permanent population as well as transient exploiters. Valuable metals drew to Dacia trade, traders, and incidentally diverse cultures. As early as the eleventh century B.C. a distinctive and high order of civilization existed here, according to archeological evidence.

Dacia has always been a farming region. The fertile plains of the Danube, Pruth, Dniester, and Dnieper produced grain which was bought by Greek traders for Mediterranean markets. The "Lords of the gold country" offered skins, fish, honey, and slaves in exchange for manufactured goods, wine and oil from the south. Archeological remains point to widespread Greek influence. Greek industrial products were well known to the native potters of the upper Theiss even in the fifth century B.C. Fragments of Greek *amphorae* are as common as native relics

of this period. Ancient commercial highways can be traced today by the presence of Greek coins found along the routes. Moldavia, Wallachia, and Dobruja are rich in treasure of Macedonian money. Thus, through commercial relations, Dacia became an integral part of the Hellenic world. And culture accompanied trade.

Exploitation of Dacia's resources continued under the Romans. Danubian grain helped relieve Roman famines. Military colonies were planted at Aquileia and Scupi to guard the passes leading toward Dacia. Gradually through military occupation, commercial relations, and the establishment of agricultural settlements, Roman influence penetrated Pannonia and subsequently Dacia. Rome's conquest of Dacia was quickly and effectively accomplished, the conquest facilitated by the readiness of the people to adopt Roman practices, particularly those of agriculture. The Danube Basin since the Neolithic Age has been a classic agricultural region; here a uniform economic life was evolved as early as the fourth century B.C. Roman settlers introduced little that was new, apart from the Latin language. Industries of the late La Tène period continued uninterrupted during the Roman occupation, and even after Rome's withdrawal. Latin elements survive today in the culture of the lower Danube region, preserved and passed on by the old Danubian farming population. "When the Slavonic invasions began, the pastoral life of Dalmatia and of Moesia Superior gradually gave way and disappeared, but the agricultural civilization of Dacia and Moesia Inferior survived." Subsequent to the decline of Roman power "Greater Dacia" fell a prey to the onslaught of Slavs, Magyars, and Germans, but Roumania maintains today a culture essentially Latin, the heritage handed on by the agricultural people of the Lower Danube region.

The translators of Pârvan's *Dacia* have contributed a worthy addition to the history of southeastern Europe. Although the book is primarily of interest to the archeologist and historian, it contains much which will appeal to the geographer.

RUTH E. BAUGH.

YARD, ROBERT STERLING. *Our Federal Lands*. xiii and 360 pp., maps, charts, and illustrations. Charles Scribner's Sons, New York, 1928. \$5.00.

Robert Sterling Yard has become known throughout the land as the foremost champion of our National Parks System. As executive secretary of the national parks association, he has been at the apex of every "flying wedge" of public opinion which has prevented political exploitation of our National Parks, or the commercial degradation of the ideals and purposes for which the National Parks were founded. It is safe to say that no one man in America is so fully informed regarding our National Parks as he, so fully con-

vinced of their worth and importance in our national life.

In 1919 he issued from the same press as this book, *Our Federal Lands*, another equally significant book, *The Book of the National Parks*, which dealt strictly with those highly specialized areas so designated. The need for *Our Federal Lands* has been pressing. We have needed it not only for the descriptive accounts of the various parcels of our national domain, but more expressly that we might have some authoritative reference to which we might turn to learn how to distinguish the various kinds of public lands and understand their several purposes; how to distinguish among "national parks" and "national monuments," and "national forests"; among Indian reservations and mineral or water-power withdrawals and reclamation projects; between federal game preserves and wild life sanctuaries. We have needed to know how these several parcels are administered and what are our rights and privileges in each. We have needed to know these things that we might the more wisely and patriotically share in the work of conservation and utilization, of protection and development, of legislation and seeking legislation.

With more means and leisure at our disposal than any people in the world has ever possessed we need to know how to use both to the best advantage; and if we are to achieve the renaissance in culture and civilization to which the material opportunities of our land summon us, we must safeguard its natural scenery and inspirational grandeur from crass commercialism or political aggrandizement in order that our children, and theirs for the generations to come, may enjoy the loveliness of our lands for their good as we do for ours. We possess in our Federal lands a richer heritage of scenic glory and majesty, as well as of spiritual and material value, that any nation of the world can claim, and this heritage we must sacredly safeguard for all posterity.

Our Federal Lands makes this possible for us. Within its covers Robert Sterling Yard has included all the essential data we need to shape our policies wisely and well. With his book as our guide, we can intelligently advocate and ultimately insure the best possible utilization of our public domain. We can lend our aid wisely to those projects which preserve to us and our descendants the rich and varied treasures of our mountains, our streams, our plains, our game, our fish, our birds, our flowers. We can rise in indignant protest and effective rebellion if some selfish individual or unscrupulous corporation, coveting some of our birthright, seeks by chicanery or treachery to steal it from us.

Our Federal Lands is a geographic source book in that it furnishes us the basic information for an understanding of the physical features of those vast resources we possess in our public domain for that most modern and most valuable use of our land for recreation in the fullest and best sense of the word. It is written in a clear, vivid, fasci-

nating style, light and easy to read despite its weight of factual content and fundamental data. Every voting citizen of our broad land ought to have a copy in his library, to which he might refer every time he reads in the newspapers or magazines of some attempt to alienate some of our public domain from the jurisdiction of our federal government.

W. ELMER EKBLAW.

MACKEY, BENTON. *The New Exploration: A Philosophy of Regional Planning*. xiv and 235 pages; 25 maps. Harcourt, Brace and Company, New York, 1928. \$3.00.

As the title indicates, this book is devoted to a philosophic discussion of regional planning. The reader is introduced to the real thesis by an imaginary trip to London Bridge and Times Square. From the former he views the streams of water, from the latter the streams of traffic. From Times Square the "eye of imagination" sees two worlds. "Immediately beneath us, we observed the streams of traffic, passing through Manhattan, streams which flow and mingle with all the great traffic and goods streams of the earth. Here is the realm of the metropolis, the mouth that receives the industrial flow, the domain of standardized existence. It is a transient and ever-changing environment. In the hinterland of the great metropolis we have visualized the industrial watershed, the parts of the country where the traffic streams take rise, first in small trickles and runnels, in farms, ranches, mines, forests, and then broadening into the vast streams of raw materials which go, as food or as basic products, into the homes and workshops of the world. Here is the realm of the indigenous, the realm of the soil, the ores, the forests, the water-power, forces, and of the other sources of life and industry. . . ."

"Cultured man needs land and developed natural resources as the tangible source of bodily existence; he needs the flow of commodities to make that source effective; but first of all he needs a harmonious and related environment as the source of his true living." The author points out the differences between the new and the old exploration. "The essentials of the old explorations were actualities; the essentials of the new explorations are potentialities. . . . The one type of worker in the old exploration was the man of science. The other type of worker in the old exploration was the explorer himself. One type of worker in the new exploration is the economist. The other type of worker in the new exploration is the engineer. . . . He (the engineer) does not really plan the switch-back, he finds it out in the mountains amid the facts and laws of nature. He does not create his own plan, he discovers nature's plan; he reveals a hidden potentiality which nature's law allows. . . . There are two worlds. They are the metropolitan world: a framework of world-wide standardized civilization which forms itself around the

traffic stream of modern industry and commerce; and the indigenous world: a quiltwork of varied cultures, each with its own environment of racial and religious setting. . . ."

The author says there are three basic "elemental environments." They are the Primeval—the environment of life's sources, of the common living-ground of all mankind; the Rural—the environment of agriculture, of local common interests and all-round human living; and the Urban—the environment of manufacturing and trade, of the community of group interests and specialized living.

The indigenous and the metropolitan worlds are discussed at length in Chapter V, "The Metropolitan America we now can visualize as a moving dynamic force making its way in various directions over the map of the United States. It represents the total result of four definite flows of population:

- "1. The Outflow led by the covered wagon.
- "2. The Reflow led by the iron horse.
- "3. The Inflow attracted by the skyscraper.
- "4. The Backflow forced by pressure from the skyscraper."

Chapter IX is an interesting discussion of "Environment as a Natural Resource." Chapters XII and XIII are devoted respectively to "Controlling the Metropolitan Invasion" and "Developing the Indigenous Environment." The final chapter treats of "Culture vs. Mechanization."

The book is indeed a philosophical treatise, but the principles of regional planning set forth are sound. Mr. MacKaye is not a geographer, but he has drawn much of his material from the domain of the geographer. "The book is one of the first pieces of applied geography in America."

The book is interestingly written. The author has used analogies frequently, yet very effectively. To those interested in the development of the environment, this volume should make an especial appeal.

FLOYD F. CUNNINGHAM.

GÜNTHER, HANS F. K. *The Racial Elements of European History*. Translated from the German by G. C. Wheeler. Maps and illustrations. New York.

As a proponent of the Nordic theory, Günther has written an interesting book, whether or not his arguments will stand the scrutiny of his opponents. An abundance of illustrations and maps bears out his points. And, the translator has not left the subject matter in unenjoyable English.

The first third of the book is given over to a discussion of the term "race," a description of the various European races, and a short chapter on "Environment, Inheritance, and Racial Mixture." The five European races, as Günther classifies them—Nordic, Mediterranean, Dinaric, Alpine, East Baltic—are described in detail as to both

their physical and mental characteristics. In a more general way the racial strains from outside Europe are treated—the Negro, Asiatic, and Oriental. Two chapters on "The Distribution of the European Races in Europe" and "The European Races in Prehistory" complete the preliminary survey.

The remainder of the book is concerned with the importance of the Nordic race in the history of the world. Fully one quarter of the book is taken up by the main chapter on "The Nordic Race in Prehistory and History." And this, may we say, is fascinating. One has a feeling of wave on wave as the Nordic peoples raise empire after empire to world supremacy; and then, the Nordic blood dispersed, diffused, killed off, the empire declines, as a darker race, less inspired and less inspiring, gains the upper hand. As Günther mentions the signs of decay, one cannot resist comparisons with present-day empires, particularly when he discusses, in two further chapters, "The Denordization of the Peoples of Romance Speech" and "The Denordization of the Peoples of Germanic Speech."

But, in the two last chapters, on "The Present Day from a Racial Point of View" and "The Nordic Ideal—A Result of the Anthropological View of History," the author leaves one with an optimistic outlook for the Nordics. Here he points out the dangers in a "racial morass" and in the decreasing birth-rate in the upper class, which is the predominantly Nordic class. But, he ends on a brighter note, with mention of the eugenic research in America and in Germany and the awakening of the Nordic to his danger. As he says, "the Nordic ideal is stirring into life."

PRISCILLA H. WEBSTER.

CARRIER, E. H. *The Thirsty Earth*. vi and 222 pp., maps and illustrations. Christophers, London, 1928.

The importance of water supply in human activities, though generally recognized, rarely receives attention in geographic literature commensurate with this importance. As vital as food, more important than raiment or shelter or tools, significant in agriculture, commerce, and industry, the problem of food supply has ever pressed upon the individual in his progress, upon the race in its evolution toward civilization. Without water to drink the man thirsts to death; without water to grow grass and grain the tribes perish; without water to grind the grains, to float the ships, to quench the fires, cities cannot endure, nor industries, nor governments, nor civilizations.

The Thirsty Earth considers but one phase of the need for water, its use—irrigation. Yet this one phase of the geographic significance of water the book treats well and exhaustively, covering the subject throughout history and throughout time. The book is divided into four parts: (I) General considerations, including the contrast between desert and garden, changing climates, methods and advantages of irrigation; (II) Irrigation of the Ancient World—Egypt, Babylonia,

China, North and South America; (III) Modern Irrigation: The Old World; and (IV) Modern Irrigation: The New World. Three indexes complete the volume: of persons and places; of irrigated crops; and of irrigation. Satisfactory bibliographies are presented at the end of each chapter.

The author has avoided controversial argument as far as possible in presenting the debatable projects under consideration or already completed. He has condensed a wealth of material into a readable volume without any apparent loss of significant fact. He has made a "dry" subject most interesting without any stretch of imagination either in matter or style. He has presented indirectly but from a regional point of view the salient features of the climate in the lands where irrigation is practised. He has, in short, produced a specialized geographic treatise of great value in a clear readable way that insures its permanent place in every geographic or agricultural library.

W. ELMER EKBLOW.

KIRKPATRICK, ELLIS LORE. *The Farmer's Standard of Living*. xiii and 299 pp., preface, table of contents, index, tables, and charts. The Century Company, New York, 1929.

The Farmer's Standard of Living is one of the Century Rural Life Books of which C. J. Galpin is editor. It is a careful analysis of the problem, though the author says, "It should be regarded as tentative rather than final" since the field shows promise of development as research is carried on in the rural social sciences. It is based on data secured from scientific investigations and is the first attempt to bring the available facts together in book form.

This volume was written for rural sociologists, farm and home economists, and farmers, who are deeply concerned about the status of American agriculture. It contains a minimum of strictly geographical material.

LANGDON WHITE.

HART, ALBERT BUSHNELL, Editor. *The American Yearbook. A Record of the Year 1928*. 892 pp. 5½ in. x 8 in. Index. American Yearbook Company, New York.

The American Yearbook, whose publication was instituted by the *New York Times* and its publisher, Mr. Adolph S. Ochs, is an annual record of the progress made in the arts, sciences, and social conditions in the United States. Forty-five learned societies cooperate in supplying information regarding current achievement in their respective fields, and the contribution of outstanding men of authority in every field makes the work a reliable compendium of events and of the advancement of learning and technique.

The volume is divided into seven parts: (I) Historical; (II) American Government; (III) Governmental Functions; (IV) Economics and

Business; (V) Social Conditions and Aims; (VI) Science-Principles and Application; (VII) The Humanities.

Each part is further divided into a number of divisions each treating a more restricted phase of the general topic as follows:

PART I. HISTORICAL

1. American Political History.
2. International Relations Affecting the United States.

PART II. AMERICAN GOVERNMENT

3. National Government.
4. State Government.
5. Municipal Government.
6. Territories and Spheres of Influence.

PART III. GOVERNMENTAL FUNCTIONS

7. Public Finance and Taxation.
8. Public Resources and Utilities.
9. Defense and Armaments.

PART IV. ECONOMICS AND BUSINESS

10. Business and Finance.
11. Agriculture and Allied Industries.
12. Mineral Industries.
13. Manufactures and Transportation.

PART V. SOCIAL CONDITIONS AND AIMS

14. Immigration, Races, and Population.
15. Social Problems and Conditions.
16. Labor and Labor Legislation.
17. Religion and Religious Organizations.

PART VI. SCIENCE-PRINCIPLES AND APPLICATION

18. Mathematics and Astronomy.
19. Engineering and Construction.
20. Geophysical Sciences.
21. Chemistry and Physics.
22. Biological Sciences.
23. Medical Sciences.
24. Philosophical and Social Sciences.

PART VII. THE HUMANITIES

25. Literature and Language.
26. The Arts.
27. Education.

At the end of each division appears a list of cognate societies with their addresses, so that it is possible for readers to know where to obtain additional information on a particular subject. A list of the forty-five constituent learned societies whose coöperation makes the work possible precedes the text.

The care with which the editors have selected as contributors men most intimately connected with, and qualified to speak most authoritatively on, the different fields, insures the dependability of the work as a record of current achievement and inspires confidence in its reliability.

The book is well indexed, one of the best criteria

of serviceability. Throughout it bears the stamp of skillful editorship, intelligent selection, and an appreciation of the need for a compendium of current progress in learning and accomplishment.

CARLETON P. BARNES.

ANSTEY, V. *The Trade of the Indian Ocean*. xv and 251 pp., table of contents, bibliography, index, maps, diagrams, and tables. Longmans, Green and Company, New York, 1929. \$3.00.

The Trade of the Indian Ocean is a splendid treatise of one of the world's most romantic as well as one of the world's most important economic and natural regions. Logically, the greater part of the volume deals with India, British Malaya, and the Dutch East Indies, which jointly account for 86 per cent (by value) of the total trade originating in the Ocean.

The book consists of eight chapters, each of which is ably and interestingly written. The title might give the impression that this is not a geographical treatise, but such is by no means the case.

Justification for treating in one book the several contrasted parts of the region exists in the presence of a common economic factor. Down to the present time, the whole area in its modern development has depended upon European capital, and ultimate economic control. There is both an economic and a physical basis for unity; in the former, it is the elaborate organization of production and trade; in the latter it is the sea.

Chapters I and II, "The Economic Characteristics of the Principal Trading Areas of the Ocean" and "A General View of the Trade and Trade Routes of the Ocean," give a bird's-eye view of the nature and size of the trade of the Indian Ocean as a whole. They are followed appropriately by more detailed chapters.

Chapter III, "The Trade of India and Ceylon," brings out many interesting and valuable points, several of which are: (1) India *per se* accounts for about 43 per cent of the trade of the Ocean; (2) it regularly imports some sugar from Germany; (3) it secures 87 per cent of its kerosene imports from the United States; and (4) 28.3 per cent of its exports in 1926 were manufactured products.

Chapter IV, "The Trade of Malaya, the East Indies, Persia, Iraq, and British East Africa," fairly bulges with valuable data. We note with interest that Singapore, with 68.3 per cent of the total trade of British Malaya in 1925, is the chief port. It owes its enormous entrepôt trade partly to its strategic location on the Straits of Malacca, partly to its great tin refineries, and partly to its attractiveness as a market for native-grown produce of the East Indies.

Chapter V, "Commercial Organization and the Problems of Plantation Production," deals essentially with three topics: (1) the organization of trade and of large-scale industrial production; (2) the characteristics and commercial effects of plantation production; and (3) the labor problem on

the plantation. Chinese, Indian, and Javanese coolies supply the labor here, not because of scarcity of population, but rather because of unwillingness on the part of the Malaysians to work either on plantations or in tin mines. They greatly prefer to produce subsistence crops and collect and barter forest products.

In Chapter VI, "The Trade in Plantation Products," the author presents an able analysis of the sugar, rubber, and tea industries and trade. Until 1925 sugar was the most valuable export of the Dutch East Indies. The bulk of the crop is produced in central and eastern Java where the climate is particularly favorable because of a marked dry season. Most of the crop is grown on irrigated rice land and the industry is a miracle of scientific cultivation and organization—in striking contrast to that in India. Javanese sugar is not refined; white mill sugar, however, is almost as pure and colorless as the refined product. The acreage is restricted by the government in order to prevent too great encroachment upon rice production—a significant matter in such a densely populated land.

The geographic aspects of rubber are admirably handled as are the merits and demerits of the Stevenson plan. Regarding the latter, the author says that the scheme has met with fluctuating and qualified success; perhaps individual estates and companies have gained, but the British industry as a whole has lost; whereas in 1922 Malaya alone produced more than twice as much as the Dutch East Indies, by 1926 it produced less.

Chapter VII, "The Trade in Minerals," deals essentially with petroleum, coal, and tin. British Malaya and the Dutch East Indies account for about 54 per cent of the world's supply of the latter. Tin-bearing materials are excavated by hydraulic sluicing and pumped out by gravel pumps. Then, the tin is separated by running water.

The eighth and final chapter, "Conclusions," summarizes the broad conclusions pointed to by the analysis, and attempts to indicate more definitely the general trend of commercial development in the areas under consideration.

Mr. Anstey has contributed notably to the commercial and geographical literature of this region. He has skillfully handled a difficult problem; he has assembled and interpreted the pieces of his vibrant puzzle, and he has given us an exceptionally fine picture of the trade of the Indian Ocean.

LANGDON WHITE.

TOUMEY, JAMES W. *Foundations of Silviculture upon an Ecological Basis*. xxv and 438 pp.; illustrations, graphs, tables, and index. John Wiley and Sons, New York, 1928. 9 in. x 6 in. \$4.00.

In *Foundations of Silviculture upon an Ecological Basis* is found a wealth of compiled material from various fragmentary American, English,

German, and Swedish sources. In the preface the author presents a historical treatise of the development of ecology as a science. He says, "As a science, it is a branch of botany, which is concerned with the relations of the individual plants, the species and the plant community to the site. It has its roots firmly anchored in the basic principles of physics, chemistry, physiography, geology, and meteorology." No single worker could be expected to have completed research in all these fields sufficiently to make an original contribution. Hence, the author claims no great amount of originality. However, his scholarly attainments in his field are reflected in the choice of original source material.

This volume is divided into two parts; namely, Part I, The Site Factors; Part II, the Forest Vegetation. Part III, The Methods of Investigating the Site Factors and the Forest Vegetation, will be published in a later volume. Part I deals with the various external factors which act upon the forest vegetation and the modifications in the vegetation due to their action. Dr. Toumey places the external factors in three categories: (1) Climatic factors, (2) Physiographic factors, (3) Biotic factors. In view of the recognition that soil science has received, a fourth, Pedologic factors, might well be recognized. The author chooses, however, to discuss the soil factors under the physiographic factors. It seems quite certain that silviculturists will have to make a more thorough study of "Phyto-pedology" before all the principles of forest ecology can be formulated and their real significance determined. In Part II is presented an analysis of the forest, the units of forest vegetation, their origin and development under the action of the site factors, and the biology of the stand, and the individual.

The book is very well written. The author handles his problem admirably. References are placed at the bottom of the pages and those interested in more detailed treatment of particular subjects can easily turn to the original material if available. Although written primarily for students of forestry, ecologists and plant geographers will welcome such an excellent volume, and Dr. Toumey is to be congratulated on having brought forth a text, the need of which has long been recognized. If he succeeds as well in the second volume as in the first, there will be available, indeed, a treatise on silvicultural and ecological methods which will be greatly appreciated.

FLOYD F. CUNNINGHAM.

HERTZ, FRIEDRICH. *Race and Civilization*. Translated by A. S. Levetus and W. Entz. 328 pp. London, 1928.

Race and Civilization—but in spite of his title the author's thesis is that race has little or nothing to do with the development of civilization. Beginning with a chapter on "Race Hatred and Theories of Race," he goes on to break down the theories which attempt to classify people according to physical differences, psychological differ-

ences, or differences in language. With all "race dogmatists" and "race dogmas" he is sometimes severe in his criticisms. All in the end intend to prove the superiority of one race, whereas Hertz maintains that "the fundamental equality of races is proved by the fact that there are innumerable parallels between primitive peoples who seem never to have come in contact. Moreover, the cultural position of the continents roughly corresponds to their physical conditions."

In the last two chapters he sets forth his own view on the development of civilizations. These, he says, arose not from the inherent qualities in the various people (which are fundamentally the same), but by the forces exerted by the physical conditions surrounding them, their development accelerated or retarded by contact with other peoples. "Nature, society, and history"—a solid foundation on which to build, and leading to reasonable and inevitable differences between nations and races rather than to the egotism of a "noble" race and the inferiority of less fortunate peoples.

Altogether, it is a scholarly work, showing familiarity with the writers, and with many notes and references further to bear out the author's points. Throughout all arguments, Hertz maintains his opinions fully as emphatically as his opponents, the "race dogmatists," maintain theirs.

PRISCILLA H. WEBSTER.

HOWELL, J. PRYSE. *An Agricultural Atlas of England and Wales*. (Made on behalf of the Agricultural Economics Research Institute, University of Oxford.) 22 dot maps of agricultural data, each 15 x 18 in. and explanatory text. Published by direction of the Ministry of Agriculture and Fisheries by the Ordnance Survey, Southampton.

This valuable atlas is indispensable to any student of English geography, agriculture, or economics, and valuable to any general student in these fields. It presents graphically masses of

tabulated agricultural data with important geographic application and significance.

The maps are on a scale of 23.67 miles to 1 inch, and include England and Wales. The boundaries are in red solid lines, the boundaries of political divisions in dotted red lines. The data are represented by the same dot system used in the *Geography of the World's Agriculture* by O. E. Baker and V. C. Finch, and in many other similar publications since, each dot having a quantitative and locational value for each map. The maps are easy to read and to interpret. They are on transparent paper so that they may be superimposed upon the physical maps that accompany the atlas.

The maps show the distribution of (1) Mountain and Heath Land; (2) Permanent Grass; (3) Arable Land; (4) Wheat; (5) Barley; (6) Oats; (7) Beans; (8) Peas; (9) Potatoes; (10) Turnips and Swedes; (11) Marigolds; (12) Vetches or Tares; (13) Hops; (14) Lucerne, Clover, Sainfoin, and Grasses under Rotation; (15) Bare fallow; (16) Horses; (17) Cattle; (18) Cows and Heifers in Milk, and Cows in Calf; (19) Cattle two years old and above; (20) Heifers in Calf, Cattle one year old and under two years and under one year; (21) Sheep in Summer; (22) Pigs. In addition excellent geological, rainfall, relief, and town maps to constitute the physical background for these maps of distribution accompany the series and are placed loose in a packet so that they may be placed beneath any of the dot maps for purposes of correlation.

Significant relationships are thus brought out by these maps between the physical factors of the environment and the agricultural activities of the people, and most interesting and valuable comparisons and deductions can be made. The agricultural status of every part of England and Wales can be most accurately determined. At a glance any interested Briton can appraise the agricultural resources of every shire.

It is an atlas of preëminent value to the people of the British Isles, and of almost equal value to students throughout the world.

W. ELMER EKBLAW.

ANNOUNCEMENT

DR. CLARENCE F. JONES has recently returned from South America after having assembled authoritative data, and studied conditions in the field, for the completion of his series on the *Agricultural Regions of South America*. His series is continued in this issue.

Due to the difficulty of assembling and interpreting statistics for part of his regions, the next instalment of Dr. O. E. Baker's series on the *Agricultural Regions of North America* has been postponed until a later issue.

Agricultural Regions of Africa, by Homer L. Shantz of the University of Illinois and president-elect of the University of Arizona; *of Australia*, by Griffith Taylor of the University of Sidney, one of the foremost geographers of the world; and *of Asia*, by Samuel Van Valkenburg of the College of the City of Detroit will follow in later issues to complete the finest geographic discussion of the world's agriculture thus far published.

To obtain the complete series of these extremely valuable articles, which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, and date back to the October, 1926, issue.

In addition to this series of articles on agriculture, other series are being initiated; every issue will also contain four or five articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

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Only a limited number of the first numbers of ECONOMIC GEOGRAPHY are available.

The July issue of Volume 5 contains the following articles:

Canada's Advance to Hudson Bay, Harold S. Patton, University of Cincinnati.
Economic Conditions in St. Vincent, B. W. I., G. Wright, Imperial College of Tropical Agriculture, Trinidad.
Economic Geography of the Hawaiian Islands, Otis W. Freeman, State Normal School, Cheney, Washington.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Iron and Steel Industry of the Cleveland District, John B. Appleton, University of Illinois.

April includes:

Agricultural Regions of South America, Clarence F. Jones, Clark University.
The Potash Industry of Europe, Fred S. Mohme, University of Illinois.
The Sugar Industry of the British West Indies and British Guiana with Special Reference to Trinidad, C. Y. Shephard, Imperial College of Tropical Agriculture.
Iron and Steel Industry of the Middlesbrough District, John W. Frey, University of Wisconsin.
The Grape Industry of Spain and Portugal, W. O. Blanchard, University of Illinois, and Elizabeth R. Blanchard.
The Philippine Lumber Industry, Luis J. Borja.

January includes:

Industrial China, H. F. James, Wharton School of Finance and Commerce.
Land Resource Inventory of Michigan, Carleton P. Barnes, Michigan Land Economic Survey.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Scranton's Industrial Integrity, Clifford M. Zierer, University of California at Los Angeles.
A Critical Situation in Two One-Crop Wheat Farming Districts in California, John W. Coulter, University of Hawaii.

The October issue of Volume 4 contains the following articles:

Fisheries of the South Atlantic and Gulf States, J. H. Matthews, Atlantic Coast Fisheries Company.
The Iron and Steel Industry of the Birmingham, Alabama, District, Langdon White, Randolph-Macon Women's College.
America's Resources in Nitrogen, Potash and Phosphorus, Guy E. Mitchell, U. S. Geological Survey.
Possibilities of Rubber Production in Caribbean America, Jewell Venter, University of Missouri.
The Kentucky Geographical Surveys: A Review, W. Elmer Ekblaw, Clark University.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.

July includes:

The Civilizing Rails, Mark Jefferson, State Normal School, Ypsilanti, Michigan.
Piedmont North Carolina and Textile Production, Jefferson Bynum, University of North Carolina.
Location Factors in the Iron and Steel Industry, Richard Hartshorne, University of Minnesota.
The Ozark Orchard Center of Southern Illinois, Ina C. Robertson, State Teachers College, Valley City, North Dakota.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Egypt is the Nile, Paul F. Gemmill, University of Pennsylvania.

April includes:

Iron and Steel Industry of the Pittsburgh District, Langdon White, Miami University.
European Forests and Their Utilization, Bruno F. A. Dietrich, University of Breslau.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Localization of the Cotton Industry in Lancashire, England, Rollin S. Atwood, Clark University.
New York Barge Canal—Expectations and Realizations, Florence Whitbeck, University of Rochester.

Single copies of back numbers of Volumes 1 and 2, 1925 and 1926, will be sent to any American address for \$1.75 each; to any foreign address for \$2.00. Back numbers of Volume 3, 1927, Volume 4, 1928, and Volume 5, 1929, will be sent to any American address for \$1.50 each; to any foreign address for \$1.75. Whole volumes may be obtained at the yearly rate.

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"Nature has been so silent in her persistent influence over man, that the geographic factor in the equation of human development has been overlooked."

ELLEN CHURCHILL SEMPLE.



